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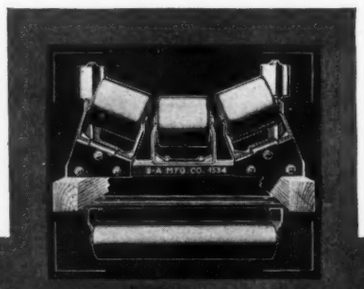

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Ore Deposits

EVERY METAL which we mine enters into the crust of the earth as a widely, almost generally, disseminated element. Gold, for example, occurs in all rocks: even, probably, in all waters save the rain—a sun-distilled water—including the waters of the ocean. Gold is a rare element, of course. As an example of the very common metals, iron forms a most important part, by weight, of the total crust of the earth. It is present in all igneous rocks and in most sedimentary rocks, and, not infrequently, in the heavier igneous rocks runs up to 20 per cent, and higher, of the total mass.

An ore deposit, then, is not simply an occurrence where we may detect, on analysis, iron, or manganese, or zinc, or gold. If it were, we might rightly classify the whole earth as one vast ore deposit. We can dig iron in our back-yards—every one of us; but it will be of too low grade, will contain too low a percentage of iron, to be commercially profitable, to compete commercially with the deposits containing a much larger percentage of iron which are found abundantly elsewhere. So, if our back-yard be in granite, the 4 or 5 per cent, perhaps, of iron in the granite is of no use to us. It is not ore. But if the granite contained 4 or 5 per cent of gold, instead, it would be ore! Indeed, we should have then the world's greatest gold mine in our back-yard.

What we mean by an ore deposit, then, is a local concentration of a metal, to such an extent that it becomes commercially valuable. And the amount that is necessary for commercially profitable exploitation is based, first of all, upon the relative abundance in the earth's crust of the metal in question—that is, its comparative rarity. An ore deposit may be thought of as representing a fractional number, of which the average percentage in the crust is the denominator, the required commercial percentage in an ore deposit the numerator; and whatever the denominator for each metal, the numerator will vary accordingly. This, of course, is a rough statement, because the value of the fraction is modified by the relative desirability of each metal, which is translated into market demand, which is translated into one of the components of price.

Ore deposits, as above defined, are concentrations formed by various processes of nature. Iron-ore deposits, for example, are laid down in the shallow seas and in the swamps, chiefly through the precipitative power of minute organisms. Probably the greatest iron deposits of the world, in all continents, are marine sediments in which the iron of dark muds has been fixed as iron silicate, by organic agencies. Typically, the silicate breaks up afterward, into iron oxide, or carbonate, and silica.

Iron is also formed in the depths of the earth, as a concentration in and from molten rock magmas, and so may occur as streaks in the igneous rock, as masses on its borders, saturating and replacing the wall rock, or even as true dikes, in the igneous rock or its intruded walls. This origin, in connection with igneous rocks, is called magmatic, while the origin in marine or swamp deposits is roughly called sedimentary. The process of segregating and drawing together of the iron from a molten igneous mass (which cools as an igneous rock) is conveniently known as magmatic differentiation. There is nothing unusual or obscure about magmatic differentiation. It is noted in every slag pot, every ingot of cast metal, in which the local differences of composition, such as those frequently shown by analysis between the margin and the center, arise from molecular segregation in the molten or semi-molten state—from "magmatic differentiation."

Mining in Eastern Siberia

TWO PAMPHLETS giving information concerning the mineral deposits of the "Far Eastern Republic" have been issued by the "Special Delegation" of that republic, from its headquarters in Washington. One covers the mineral resources in general, one the gold resources alone. In a way they are compilations of some interest, being an attempt to present the list and approximate value of the mineral deposits of Eastern Siberia, in the endeavor, plainly, to interest American capital in entering that troublous and uncertain field. A great many detailed notes are given as to the mineral localities of the region, yet without making possible any definite conclusion other than that the country has a considerable and varied mineral wealth. Engineers' reports, even in our own favored and technically advanced country, are far too often quite unsatisfactory; and naturally this chance is much increased in a region like the "Far Eastern Republic."

Concerning the "Far Eastern Republic" we know little, but we do know a great deal concerning the "Russian Socialistic Federative Soviet Republic," which is mentioned in these pamphlets as if working very harmoniously with the "Far Eastern Republic"; so we wish to protest, first of all, against the degradation and slandering of the word "republic." The United States is a "republic"; hence we ought to defend the fair name of our type of government. The government of Moscow is not a republic; it is a tyranny, as far from a republic as was the Czar's government, and far less intelligent. It is not Socialist; the Bolshevist graves and prisons are full of Socialists, thrown there for their opinions. It is not Federative; it is a central-controlled dictatorship. It is not even Soviet, which implied originally a form of government built up of a series of simple representative councils. The only true designation is Russian. Therefore we must at once strip off the word "republic" from the Far Eastern organization also.

What, then, has the Far Eastern government to offer as an inducement to American capital to prospect and

invest; and to American engineers to labor, worry, and grow gray-haired in endeavor? The advantage which the government will enjoy is plain: it receives a certain substantial proportion of the results of mining—determined, apparently, largely by dickering with the government when obtaining the "concession." The concession is a lease—nothing more. No ownership goes with it. For gold mining the tax varies from 5 per cent for mechanical placer mining to 12 per cent for hand labor on the "piece" system, of the *gross value* mined, besides an annual area tax.

A casual inspection of the mining regulations leads to the conclusion of "too much government," even if all other conditions were pleasing. We doubt if any honest mining man will adventure in the Far Eastern government his own money or future after encountering the following illuminating provision:

"18. The Ministry of Industry has the right to maintain at the enterprise of the concessionaire a number of persons—the number to be specified by the contract—for the supervision of the activities of the enterprise. For these persons the concessionaire is to provide, free of charge, lodgings, with fuel, light, and water."

For the rest, one may perhaps devise some impolite amusement from the descriptions of the geology of one ore deposit. We read that:

"According to the opinions of local geologists, the original source of the earth's gold is the mineral-mass of the gneiss' nature, and in particular, the horneblende contained therein. That rocks that contain horneblende in great quantities are exceedingly auriferous is a fact beyond question. It has been definitely established." It also is stated that "Vein-quartzes as a rule show but little gold content." Among the rarer "crytallic" rocks are listed "diabastos and prophyrites." Elsewhere we note the term "polyphyries."

As to the total estimation of ore in the ground: "The data derived from geological and other researches enables us to state that ore deposits contain many tens of thousands of poods of gold"—and a footnote states: "One pood = 36.11 pounds," thus enabling us to compute accurately the amount of gold in this promised land.

Sulphur-Dioxide Leaching of Copper Ores

LARGE TONNAGES of copper ores in the Southwest consist of mixed sulphide and non-sulphide copper minerals; the original sulphides have in most instances been oxidized in the upper zones of the mine. No definite line of demarkation exists, and it is not possible to mine ore entirely of one kind, although sometimes a selection can be made, sending part of the ore to a leaching plant and the rest to a concentrator of the usual type embodying tabling and flotation. Much work has been done on the so-called mixed-ore problem, the aim being to devise a process which would make a good recovery of both sulphide and non-sulphide copper minerals in one continuous process and at a cost which would make the process commercially successful. Though several methods have reached the stage of semi-commercial application, none has been so outstandingly successful that it has been widely accepted as a solution of the problem. Some of those which have attracted the most attention have been the sulphide filming work done at the Shattuck-Arizona plant, at Bisbee; a combination of roasting and leaching carried on at Clifton and elsewhere,; various modifications of sulphuric-acid leaching which have been tried on an experimental scale at several plants; and sulphurous-acid leaching, largely sponsored by the Southwest Experiment Station of the U. S. Bureau of Mines.

A brief history of the process in which sulphur dioxide is used has been prepared for the *Reports of Investigations* series of the Bureau of Mines and is soon to be published. A more complete report will appear later as "Technical Paper No. 312." In view of the fact that these reports will be available through Government agencies we shall not needlessly republish them, but the subject is one of importance.

It is interesting to observe that Mr. van Barneveld has not been deterred by early failures and has apparently made progress during the last year. In the way in which the sulphur-dioxide leaching process was first applied, fairly good metallurgical results were obtained, but adoption of the process on a commercial scale was not attractive. The Miami Copper Co. gave the process an exhaustive trial up to a comparatively recent date, but gave up the work in favor of sulphuric-acid leaching following the successful application of that method at the neighboring Inspiration mine. Practical absence of soluble iron and other impurities in the ores of this district make a dilute electrolyte carrying about 1 per cent copper practicable. Much valuable information on the use of sulphur dioxide was also obtained in the work done in conjunction with the Arizona Copper Co. at Clifton, which was terminated when the property was closed down about a year ago.

One of the most unfavorable features of the early work in using sulphur dioxide was the refractory nature of copper silicate minerals toward this reagent. In both the Clifton and Miami experiments, as well as in the earlier ones, the barren leaching solutions were run to waste, and not reclaimed, as would be natural in large-scale commercial work. These barren solutions contain ferrous sulphate, and when returned to the sulphur-dioxide leaching drum, it has recently been found by the Bureau, can be used to produce a weak sulphuric-acid solution which is much more effective against the refractory copper silicate. The ferrous sulphate is easily oxidized, in the presence of sulphur dioxide and oxygen, to ferric sulphate; and this ferric sulphate then reacts with the sulphur dioxide to form ferrous sulphate and sulphuric acid under conditions which can be brought about in the leaching drum. Thus the Bureau has devised a process which uses sulphurous acid direct so far as it is an efficient solvent, and which in itself is a cheap producer of such sulphuric acid as may be required.

The further steps in the proposed process include aërating the pulp from the leaching drum; precipitating the copper on sponge iron; and recovering the cement copper so produced, by flotation. These steps have been found, for one reason or another, preferable for research work, to other better-known methods of recovering the dissolved copper, such as by electrolytic means, or by precipitation on scrap iron.

Those who are keeping themselves informed concerning the wet metallurgy of copper will follow this work at Tucson with interest. Sulphur dioxide is a cheaper reagent than sulphuric acid, and some of the obstacles to its use are being gradually overcome. In places where gases from roasters are now discharged to the air, it will cost nothing. It must be used hot, the effluent pulp from the leaching drum having a temperature of about 50 deg. C., for best results. Most hot processes are doomed to failure by the cost of heating, but

here the gases are naturally hot and we take it that extraneous fuel is not required.

A difficulty that we foresee is the upkeep of the leaching drum. The device which has been developed contains numerous baffles and lifters designed to provide intimate contact between the gas and pulp, and we assume that it is made of wood. Possibly in large installations it might be made of metal. In any case the presence of hot acids (sulphuric as well as sulphurous) and the action of the gritty particles of the ore pulp would not be conducive to long life. The production of sponge iron on an economic scale cannot yet be said to have been solved, though we understand that the process developed by the Chino Copper Co. has attractive possibilities; possibly the Bureau has a satisfactory method in mind. And the last step, the flotation of the cement copper, has so far proved disappointing, possibly, as Mr. van Barneveld and Mr. Leaver state, on account of the nature of the precipitate produced by the use of scrap iron. Sponge iron may make a product offering less difficulty in flotation.

We hope that Mr. van Barneveld and his associates will be successful in their further work, for the problem which they are attempting to solve is undeniably an important one.

Mine Stock Promotion

WHILE PARTICIPATION in most of the most favorable ventures in mining never is offered to the public, the capital being subscribed by small private groups, or furnished by some large company, yet the offering of stock to the public is on occasion as legitimate in mining finance as in any other sort of enterprise. The requirements for honest promotion and stock-selling are as simple in mining as in other enterprises; only in most other enterprises they are more frequently observed. They are that the facts and business figures pertaining to the enterprise be impartially submitted, supported by the reports of experts known to be independent—accountants, lawyers, and engineers. No participation in the stock of a public-utility enterprise is ordinarily offered to the public without the report of a firm of engineers of recognized standing and independence, and ordinarily a clear statement of the present financial condition submitted by a well-known firm of public accountants.

Mining stock offerings should of course be accompanied by the same reasonable and fair submission of facts and conditions. Even with all these, investments in any enterprise, mining or otherwise, partake of the nature of a speculation. But the public has a right to at least a plain statement, and thereafter the buyer of stock takes the risk which goes with his purchase. But it seems to be true that the picturesque elements of mining have been seized upon by a cheaper, less scrupulous type of promoter than the ordinary, to induce the public to buy through the emotions rather than the judgment; and, therefore, in disgusting sequence come out bids for the public money, supported only by the cheapest kind of sentimental rubbish—get-rich-quick, "come-on" stuff, such as is the usual scenery set by confidence men and swindlers. Such methods should be left to this class of undoubted rogues; for men who hold themselves honest to practice this kind of emotional, fact-evading stock selling, is for them to skate so near the edge of the open water that ten to one they are in it sooner or later.

Moreover, the ignorant and credulous public has a right to expect protection from such hollow and sly enthusiasm; if not by the promoters, at least by reputable engineers and the reputable mining press; and all those who hold that mining is a most honorable and sober industry, and not a pool where the slick promoter may fish for suckers, for bucolic stockholders to hold the sack, so that in any case he shall not lose.

One trouble is, sad to say, that the promoter, who is apt to be something of a child as to fundamental ethics, meets a wiser but if anything less scrupulous mining engineer who is quite willing to fall into any promotion scheme which would yield him some money. Such an engineer will furnish glowing generalities to the promoter for a consideration—generalities singularly lacking in cold and measured appraisal of facts. Such engineers are a disgrace to the profession.

The type of engineers, of mining men, who regard any methods whatever as praiseworthy provided they succeed in bringing in money for development and activity are parasitic and pestilence-breeding—they betray an industry which in its normal and honest form is peculiar in its nobility and its lack of parasitism.

Atmospheric Oxygen for Cutting Steel

THE UBIQUITY of oxygen in the atmosphere, and its influence on sundry reactions, are often unrecognized. In a recent issue of the *South African Mining and Engineering Journal* a short article discussed the use of a mild-steel disk with notched edge for the cutting of metal. Many mining engineers are unware of the fact that if such a tool be mounted on an ordinary saw bench and revolved at a high speed it can be used to cut piping, joists, or other structural steel. The scope of application, however, would be limited if our contemporary's interpretation of the phenomenon be accepted, for it maintains that the result is attained "simply by the heat of friction."

As when the oxy-acetylene burner is used, the heating of the metal is the first step in the operation, not the last. A considerable amount of heat is generated when a steel disk is used for cutting, but this is insufficient to melt steel. The cutting in both cases is due mainly to the chemical erosion of the metal by oxygen. In the oxy-acetylene apparatus the cutting gas is supplied in an almost pure state from cylinders; when a steel disk is used, the oxygen needed comes from the atmosphere. A temperature favorable to rapid oxidation is reached almost immediately after the metal is placed against the disk, the rapid movement of which insures a steady supply of the necessary gas. The results are, of course, inefficient as compared with those obtained with the oxy-acetylene cutter; further, in consequence of the lack of portability of the saw bench and the clumsiness of the apparatus, the scope of the disk cutter is limited.

Recently, much interest centered on the achievement of cutting a large cast-iron pipe that lay in 50 ft. of water in New York Harbor. A new type of electric torch was used, but the pseudo-scientific publications overstressed the part that was played by electricity. Precise details are unavailable, but it would appear that although the arcing of an electric current was used to obtain the necessary preliminary heat, the cutting was performed by some gas or combination of gases, the composition of which is not known. In any event it is probable that oxygen played an important part.

THE JOURNAL-PRESS STAFF

GEORGE JOSEPH YOUNG

OF THE West Western is George Joseph Young, Western Editor of the *Journal-Press* and Editor-in-Chief of the *Pacific Mining News*, a supplement to the *Journal-Press* and the most recent member of the McGraw-Hill publications, devoted to the interests of the mining industries west of the Rockies.

Mr. Young was born in California, in 1876, his father, Joseph Young, having been a pioneer of northern Arizona, and his mother, Marion Wilburn, herself a native of southern California. His early education was obtained in the public and high schools of San Francisco, after which he entered the Department of Mining of the University of California, taking also German, English, and art studies in addition to the technical course, and being graduated in 1899. After graduation Young acted—in 1899 and 1900—as research assistant to Professor Christy in the mining department of the university, going in 1900 to the University of Nevada as assistant professor of mining and metallurgy, at which institution he also became a professor of mining and metallurgy, and where he finally assumed charge of the McKay School of Mines, in 1908. During the period from 1900 to 1913 he was in charge of the State Analytical Laboratory, and also, during 1912-1913, was director of the Co-operative Potash Laboratory, which was established jointly by the U. S. Geological Survey, the Bureau of Soils, and the University of Nevada, for the purpose of assisting prospectors and others in search for a source of commercial potash in the Western states.

GEORGE JOSEPH YOUNG

During most of the time which Young spent at the University of Nevada he was chairman of the scholarship committee of the university. Also, while there he reorganized the mining courses and equipped the school with new laboratories. In 1909 and 1910 he traveled in Europe, visiting mining and technical schools and studying coal mining in Germany and England. He spent his summers in the West, visiting and studying mining conditions in many of the districts of Montana, Utah, California, Arizona, and Colorado. From 1913 to 1917, Young served as professor of mining in the University of Minnesota and as professor of metallurgy at the Colorado School of Mines. In 1918 he became Assistant Editor-in-Chief of *Engineering and Mining Journal* and later Western Editor of the paper, and in April, 1922, he assumed the chief editorial responsibility of the *Pacific Mining News*.

Mr. Young's activities, aside from his work as a teacher, have covered many and varied subjects. A student of mining and metallurgy since 1895, he has made, also, a thorough survey of mining publications. His first contribution to *Engineering and Mining Journal* appeared in 1904. In 1918, 1919, 1920, 1921, and 1922 he had charge of the Annual Progress numbers of the paper. His contributions to the literature of the industry, in addition to mining papers and articles that are familiar to readers of the *Journal* and the *Journal-Press*, included "Elements of Mining," written in 1916; "Salines in the Great Basin Region," in 1913, a bulletin of the U. S. Bureau of Soils; and the following contributions to the American Institute of Mining and Metallurgical Engineers: "Ventilating System at the Comstock Mines," 1909; "Slime Filtration," 1911; "Fires in Metalliferous Mines," 1912; "Brown Coal Mining in Germany," 1916, and "A History of Mining in Nevada," published as a part of the history of that state. His research work has covered mine ventilation, the cyanide process, copper ore leaching, gold and silver metallurgy, filtration, magnetic and electrostatic separation, flotation, and magnetizing roasting.

Perhaps nothing can so mellow a man as the experience acquired in the moulding of the character and mind of the students who obtain their first conception of mining in Western universities. There the embryo engineers are frequently an especially vigorous type, and contact with them en masse usually produces the customary result. When Young entered the field of technical journalism, his first action was to declare that henceforth "Professor" was taboo. He has shed the title.

The subject of this sketch years ago on his mountain trips packed both rod and gun. He once landed a 5½ lb. trout in the Truckee, and has brought down many a deer, but game have in most ranges become too small and scarce for sport, and he now hunts with the camera, and some of the finest photography that has been published in this journal was the result of his summer excursions in the Sierras. When other members of the expedition are catching fingerlings or hugging camp, Young will be away somewhere, climbing a peak to get a particularly striking photograph. The last issue of the bulletin of the Sierra Club contained some notably beautiful pictures of Mount Darwin, caught from high ledges by Young's camera. Mr. Young is a member of the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society, the Sierra Club, and the Engineers' Club of San Francisco. He makes his home with his wife and daughter in Oakland—and spends his vacations among the peaks of the Sierras.

The Mining Corporation of Canada

BY T. A. RICKARD

AMONG the so-called exploration companies engaged in finding, developing, and exploiting mines on the American continent, the Mining Corporation of Canada has won an honorable name for skilful enterprise and fair dealing. The company is registered in Canada and at a recent informal meeting in London its English shareholders had an opportunity of hearing an account of its operations from the president of the company, Mr. J. P. Watson. He has been identified for many years with successful mining at Cobalt, where the principal holdings of the company used to be: the Cobalt Townsite, City of Cobalt, and Cobalt Lake mines. The company was organized by Rose, Van Cutsem & Co., of London, in March, 1914.

Although the company's Cobalt properties yielded 1,250,000 ounces of silver last year, it has been stated repeatedly by the management that they are approaching exhaustion, except the Buffalo mine, a recent purchase, which shows signs of prosperous vitality. The cost of producing silver in 1920 was 65 cents per ounce; between 1919 and 1921 the price of the metal fell 40 cents per ounce; so that it can be understood why the company has had 'hard sledding' of late in trying to make money at Cobalt. However, thanks to a reduction in wages and an increase of efficiency in labor, the cost of winning the silver has been reduced about 30%, according to Mr. Watson.

Mr. Watson spoke with an air of frankness at the annual meeting and created an excellent impression thereby. Among other things he acknowledged two mistakes. A mine in British Columbia had been prospected under option, on the report of two engineers, the second of whom confirmed the report of the first, but both were wrong, as was ascertained when an examination was made by the company's chief engineer, Mr. Scott Turner. Another property, in the same Province, proved to be a 'teaser,' as Mr. Watson termed it most appropriately. It contained a small ore-shoot sufficiently promising to justify development, but not large enough, as was shown eventually, in a report by Mr. Oscar Hershey, to warrant the purchase of the property. However, the Buffalo, at Cobalt, has redressed the balance, for the owners sold it to the company in the belief that it was on its last legs and contained only 350,000 ounces of silver. In 1921 the company won 700,000 ounces from this supposedly exhausted mine, and there is now 1,500,000 ounces in the ore-reserve.

Next we come to the Company's principal new holding, the Flin Flon, a big copper mine in Manitoba. Readers of the 'Mining and Scientific Press' will recall an article entitled 'A New Canadian Mining District,' by Walter Karri-Davies, in the issue of October 13, 1917. In that article Major Karri-Davies described the new district and indicated how difficult of access it is. This part of Canada could be described by a geologist as a country of inundated *roches moutonées*; it is a glaciated country dented with strings of lakes. Therefore it is most accessible in winter, when the roads are bridged by ice. The chief point of departure is the town of The Pas, on the Hudson Bay railroad. From there the traveler goes tortuously, by steamer and wagon, to Flin Flon lake, where this property lies. Four miles to the south, on Schist lake, is the Mandy copper deposit. This was discovered and located by a prospecting party led by Mr. J. E. Spurr, for the Tonopah Mining Company, of which he was vice-president and engineer, in 1915, as described by Mr. Spurr in an article entitled 'The Discovery of the First Operating Mine in Manitoba,' which appeared in the Engineering and Mining Journal of March 13, 1920. From this mine a quick and handsome profit was made by the Tonopah Mining Company, by shipping the ore to the smelter at Trail, in British Columbia, but the high-grade ore being exhausted, the mine is idle now.

From The Pas to the Flin Flon mine is about 70 miles by air, but fully 140 miles by land and water. Five years ago the orebody was known to be 200 feet wide; it had been diamond-drilled for a length of 2000 feet and to a depth of 600 feet. At that time, the average assay was 2% copper and 5% zinc, with $2.50 in gold and 1¾ ounces silver per ton. Major Karri-Davies stated at the time: "It is recognized by those directing the enterprise that a larger tonnage of such ore will have to be proved before it warrants the big expenditure necessary to develop a productive mine." This has been done since then. Mr. Watson states that his company joined in the venture with a New York syndicate, headed by Mr. W. B. Thompson. The previous diamond-drilling was confirmed, at a cost of one year in time and of $400,000 in money. The favorable confirmation of the technical evidence came at a time of financial crisis, and that was why the New York people withdrew from the venture, which was then carried forward by the Mining Corporation of Canada. It is estimated that 16,000,000 tons of ore is assured, and the possible resources of the mine are placed at 22 million tons. So far about $600,000 has been spent in engineers' reports, preliminary workings, and temporary equipment. The drill-holes showed 1.82% of copper, $1.60 in gold, and 1.16 oz. of silver per ton. During the later prospecting another and richer vein of ore was cut in the foot-wall; this raised the average to 2.4% — an increase of 30% — so says Mr. Watson—in the general average of the ore in reserve. The estimated value of the metals in the 16 million tons of ore is $150,000,000, of which $26,000,000 is gold, $13,000,000 is silver, and $111,000,000 is copper. The metallurgical recovery of these metals is expected to be from 78 to 80%, but, as Mr. Watson says, "there is a vast difference between £30,000,000 odd in the wilderness—in Manitoba—and that same amount of money in the bank." Several years must pass before the wealth of the Flin Flon is realized in terms of dividends. Between Winnipeg and the Arctic, between Lake Superior and the Yukon, there lies a great stretch of country that has been only slightly searched by competent prospectors; it is a region in which travel is difficult except in winter, and in winter the surface of rock is mantled with snow, so that intelligent examination is hindered. If the Flin Flon proves a success, the district will be connected by rail with the outer world and the prospector will be given another *pied à terre* from which to extend his exploration into the lone land northward that awaits the awakening touch of human industry.

DISCUSSION

Vein Nature of Commercial Borates

Novel Characteristics of the Colemanite Deposits of California and Nevada

THE EDITOR:

Sir—There is one feature concerning the colemanite deposits of California and Nevada which merits especial notice as having critical yet hitherto unrecognized bearing upon the theory of metasomatic replacement of limestones by calcium borate. This feature is a decisive test of the alleged vein character of colemanite deposits. I refer to the faulting of the colemanite beds themselves. Faulting occurs in all the borax fields, although it is not noted in any of the descriptions.

In one instance noted, the inclined strata are shifted horizontally, so as to separate the two parts of a borate bed over 300 ft. The slips are oblique to the dip and strike, and about midway between the two. Although the direction of the movement is horizontal, the dislocations are manifestly due to relief of torsional stresses, perhaps set up when the great blocks now occupied by the borate basins were faulted and depressed (1,000 ft. or more). These faults cut off sharply both the borate beds and the associated clays and sandstones. These features are not displayed at the surface of the ground, because obscured by weathering of the deposits and on account of overwash; but they are clearly shown in the mine tunnels, a hundred yards or so beneath the surface, where they are so clear and fresh that they are fit objects for photography.

Were the borate beds really mineral veins in the true sense of the word they would have been developed as such after the tilting of the strata in which they occur, and after the fissuring due to the faulting, but there is no evidence of this. The borate beds were without question formed before the faulting: nodules and individual crystals are sharply chopped off.

There appears to be a secondary deposition of colemanite which doubtless originated from the solution by the rains of the outcropping inclined bed. These secondary solutions seeped down along stratification planes into the fault fissures. Where the faults were slightly open, secondary colemanite was thus redeposited in a continuous sheet, an inch or two thick, passing directly across the bedding planes of both the original colemanite beds and the associated shales and sandstones. These vertical slabs of secondary colemanite are easily distinguished at a glance from the original beds. They are composed of fine, long, closely appressed, needle crystals disposed at right angles to the fault planes, and taken as a whole resemble the thin veinings of satin-spar which traverse red shales occurring 100 ft. beneath the borate beds.

In a single cubic yard of the borate-bearing deposits there are to be found the massive bedded colemanite (which might well recall to mind a limestone bed and at first glance be easily mistaken for such), the clay layers carrying large nodular masses of colemanite, the blue shales through which is disseminated finely divided colemanite, the lamellar clays in which are interspersed paper-like films of colemanite, and the veining plates of needle colemanite, which cut across all the others.

The vein theory of colemanite formation possesses, to be sure, one commercial advantage. As is well known, most borate claims are located in accordance with the lode rules; yet many other borate claims are held by placer regulations. These often overlap in a bewildering manner. Frequently, the lode claims are plastered over by placer locations. The latter are larger than the former, and perhaps have better intrinsic rights. When mining of these shall begin upon these properties, there must inevitably and automatically arise an immediate conflict between different interests. The outcome bids fair not only to turn into turmoil the entire borax industry of our country, but speedily to accomplish its irremediable ruination.

Des Moines, Iowa. CHARLES R. KEYES.

Dealing With Prospectors

THE EDITOR:

Sir—Mr. Brunel's letter in your issue of June 3, in which he enlarges on the devious ways of the prospector, leads me to the conclusion that he has failed to understand the character of that individual and has met few prospectors. The subject is one on which much has been written, but perhaps it is not entirely exhausted.

In the first place, the prospector is just an average human, with a disposition to get the better end of a bargain if possible, like all the rest of us; and when dealing with him this should be kept in mind. In the case cited, business methods were omitted. Mr. X was not tied up with an option at $3,500. Hence, when he found that Mr. B, after a preliminary consideration of the vicinity in the books, was interested, he considered himself free, and accordingly advanced his price. Almost any vendor of real estate would have done the same under similar circumstances, though probably not to the same extent.

There are several kinds of people these days besides the prospector who are trying to get "all that the traffic will bear." It is a very human trait. The remedy is to bind him with an option, or to get his verbal refusal before witnesses for a definite price and a definite time. His word will be found quite as good as that of the average man. If these simple precautions have not been taken he should not be blamed for trying to improve his status.

In the second place, few prospectors are developers of their claims except to the small extent necessary to show that values have been found. Their rôle is that of the *discoverer*, and they are usually deathly afraid of having their claim explored while owning it. Their talk of a half interest for development money is a "blind," to make you think they have confidence in

their find. Not they! They have seen too many promising "prospects" ruined by a few blasts. What they want is to sell outright on the strength of the showing now, and use the money to finance an effort to find something better. Every prospector has in mind several localities he desires to visit and explore, and in each of which he is confident he can uncover a wonder.

Hence, the best way to deal with this worthy individual is to go with him trustingly to his claim, and carry a little cash in your pocket. If his showing is promising, offer him from $25 to $100 on the spot for a written time option at a low price for the whole title, and in nine cases out of ten you will get the layout at your own figure. The money you will then have risked will be no more than the value of the time he has given to making the discovery, so the gamble is nearly an equal one.

The prospector is usually a good sport. Give him an opportunity to deal with you on equal terms and you will generally find him ready to play a straight game.

Denver, Col. THEO. F. VAN WAGENEN.

Tellurium in Wireless Telephony

THE EDITOR:

Sir—I noticed in your issue of May 20 that you call the attention of mining companies and individuals to the wide use of crystals of certain minerals in the construction of wireless-telephone detectors.

It may be of interest to your readers to know that the element tellurium, which has long had but few uses and with which all Western miners are more or less familiar, has been found to have superior qualities as a crystal detector. I am informed that one of the large and well-known electrical companies now has on the market a crystal detector which is more sensitive and which remains in better adjustment than anything heretofore produced. This detector consists of a crystal of tellurium resting against a crystal of artificial zinc oxide.

It seems that crystal detectors have great possibilities, as they are much less expensive than vacuum tubes and require no batteries. It is quite conceivable that experimenters will develop crystal detectors which are far superior to any of those now on the market, and in this connection tellurium crystals, in conjunction with those of other minerals, will come in for their share of attention. F. F. COLCORD.

New York City.

Sampling Wet Material

THE EDITOR:

Sir—With reference to my previous article "Examining Minerals in Ore Pulp," in *Engineering and Mining Journal*, Dec. 24, 1921, on page 1022, a further suggestion has been found convenient. Though simple, I pass it on in the hope that you find it of interest.

To examine a sample of *wet* material it is best to use a clean slide not greased; drop a small patch of sample upon it, and then, to remove any surplus liquid, apply a piece of blotting or filter paper to the edge of the patch. Turn the slide with the glass side up and examine with the microscope. It is advisable to exercise care as to shaking the slide before mopping up the water, as the movement may result in concentrating the mineral on the glass, which may or may not be advisable.

When a tailing or residue is being examined to determine what amount of mineral remains in it, it may be of advantage to put the sample on a thin watch glass, and while excess water is present give the glass a panning motion to bring the mineral together on the surface. Then remove water, invert and examine.

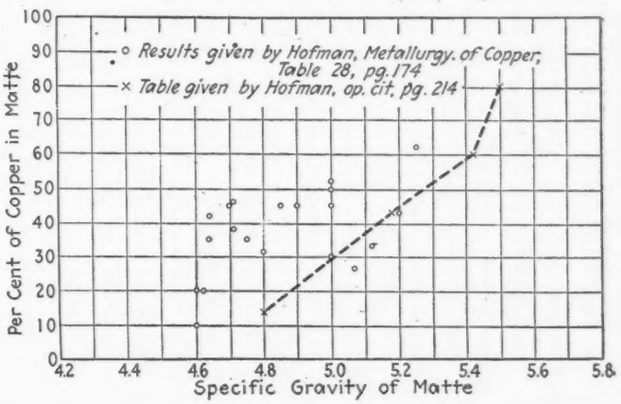
It is usually preferable to remove slime from the sample by gentle washing or elutriation before examination, as with low power, especially, slime particles are differentiated with difficulty, and interfere with the visibility of larger grains. ALFRED T. FRY.

Queenstown, Tasmania.

Copper Content and Specific Gravity of Copper Mattes

THE EDITOR:

Sir—Your editorial in *Engineering and Mining Journal-Press* of May 27, 1922, regarding the suggested feasibility of estimating the approximate copper content of mattes by means of a specific gravity determination has been read with interest. The accompanying plot was made from data published by Hofman. The group of results connected by broken lines was probably obtained on mattes in which the elements present other



than copper and iron were fairly constant. The other results plotted were from mattes made in many different plants, and may or may not have contained lead, zinc, and other impurities.

These results seem to indicate that the method could not be universally applied on all copper mattes, but it might give concordant results on mattes from individual plants with a possible limit of accuracy of from 0.5 to 1.0 per cent copper. It is believed that the matter should receive further study. To this end a more extended investigation has been started on a large variety of commercial mattes as well as on a series of mattes produced in the laboratory. W. F. DEITRICH.

Stanford University, Cal. WELTON J. CROOK.

The Ajo Enterprise Series

The fourth installment of A. W. Allen's article, "Ajo Enterprise of the New Cornelia Copper Co.," should have been published in this issue. Unavoidable circumstances have prevented the manuscript and illustrations from reaching us, but we hope to publish it in a subsequent edition.

In the *Journal-Press* for June 10, certain erroneous footnotes were given in the article "Ajo Enterprise of the New Cornelia Copper Co." On p. 1004 the reference should be Vol. 52 instead of Vol. 51; p. 1007, p. 830 instead of p. 380, and on p. 1008, p. 830 instead of p. 380.

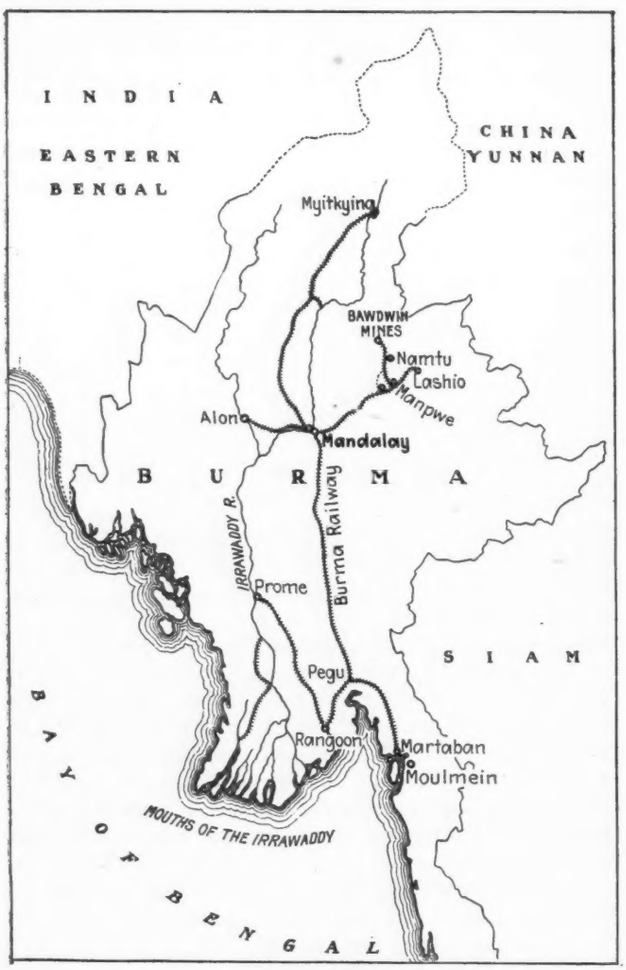
The Bawdwin Mine, in Burma

Early Methods of Mining and Smelting Silver-Lead Ore by the Chinese, Who Worked the Deposit in the Fifteenth Century—Present Mining Operations by the Burma Corporation, Ltd.

By Allan B. Calhoun
Mine Superintendent, Burma Corporation, Ltd.

THE BAWDWIN MINE is situated in the semi-independent State of Tawng-Peng, one of the small group comprising the Northern Shan States in Upper Burma. Each of these states has its own *sawbwa*, or chieftain, who rules the people under the advice and direction of a British "superintendent."

Bawdwin is 450 miles north of Rangoon, the capital of Burma, 169 miles northeast of Mandalay, and about fifty miles south of the Province of Yunnan, in China. The



Map of Burma

elevation of the mine is 3,100 ft. above the sea. The climate at this elevation is comparatively healthful during the dry season, but rather depressing during the wet. The dry season extends from November to May, and during the remainder of the year the precipitation amounts to 60 or 70 in. Most of this is in the form of heavy showers, which cause considerable damage to the railroad.

Early records and inscriptions state that the mine was operated by the Chinese in the ninth year of the reign of Yung Lo, of the Ming Dynasty, 1412 A. D. It was known as Lao Yin Chang, meaning "old silver mine," and was worked most extensively during the reigns of Chia Ching, 1796-1821, and Tao Kwang, 1821-1851, during which time it was the source of great wealth. During the reign of Tung Chik, 1868, the mine was abandoned for one or possibly all of the following reasons:

1—The Panthay or Mohammedan rebellion broke out at this time in the neighboring Province of Yunnan, China, making life and property insecure and at the same time blocking the route to China.

2—As a corollary to the rebellion, the neighboring tribes of Kachins—a war-like mountain race—took advantage of the turmoil and the fact that the mine was cut off from China, and ruthlessly raided the mining population.

3—The third reason, and probably the most important, was the difficulty of operating the mine on account of water, poor ventilation, and entire lack of machinery.

From conditions in old workings recently opened, it appears that the Chinese were pumping water in a series of lifts through 6-in. bamboo pumps a vertical distance of 160 ft. The longest and lowest drainage adit was driven through the country rock a distance of several thousand feet, to tap and drain the orebody. The difficulties encountered in this work must have been great, and the work was probably done at the sacrifice of many lives. How the early miners ventilated these long tortuous adits, how they took care of large bursts of water, and carried out the ore, is inconceivable to one who does not know the Chinaman. There is nothing too laborious or too slow to try his patience and perseverance.

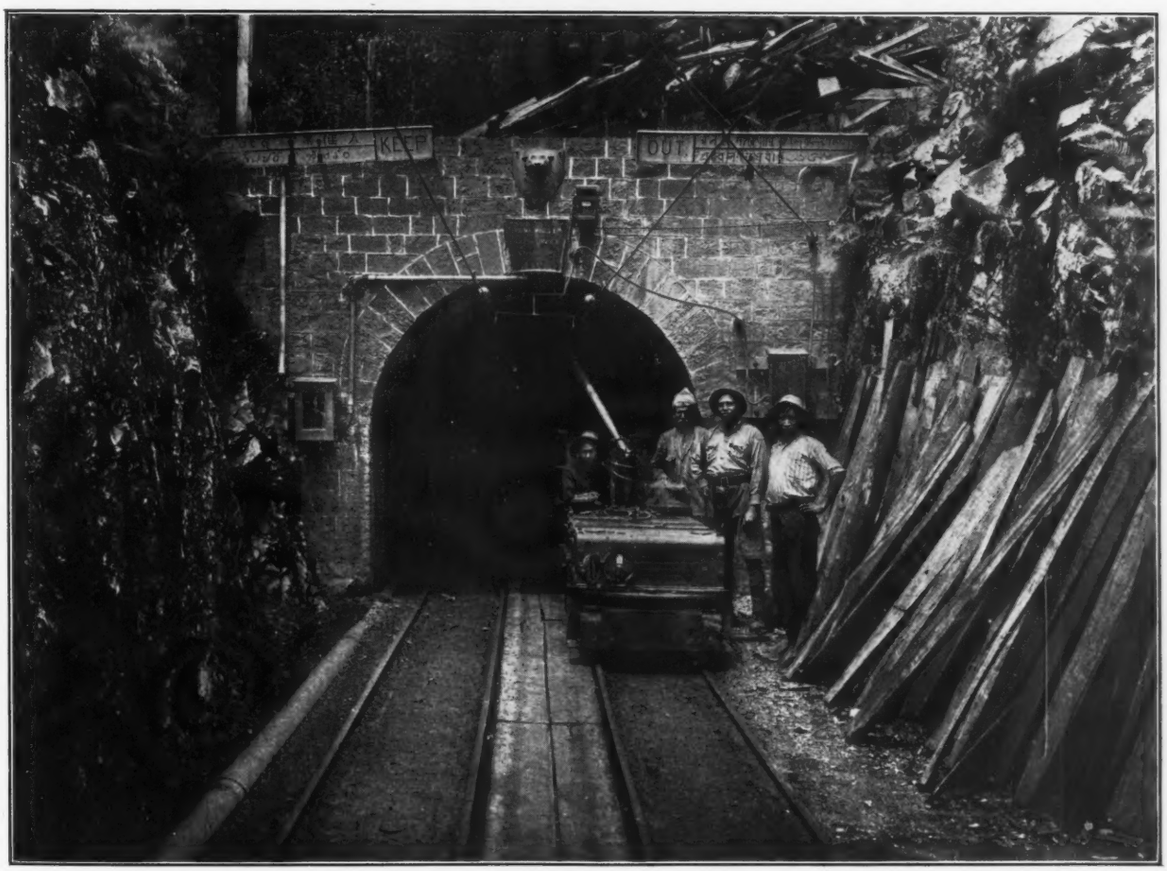
This long adit has been enlarged and extended, and is now No. 2 Level drainage adit, or, more familiarly, "Dead Chinaman" tunnel. The latter name was given to it on account of finding the skeletons of Chinese with manacles still encircling their bones.

Problems of Drainage and Ventilation Ended Early Operations

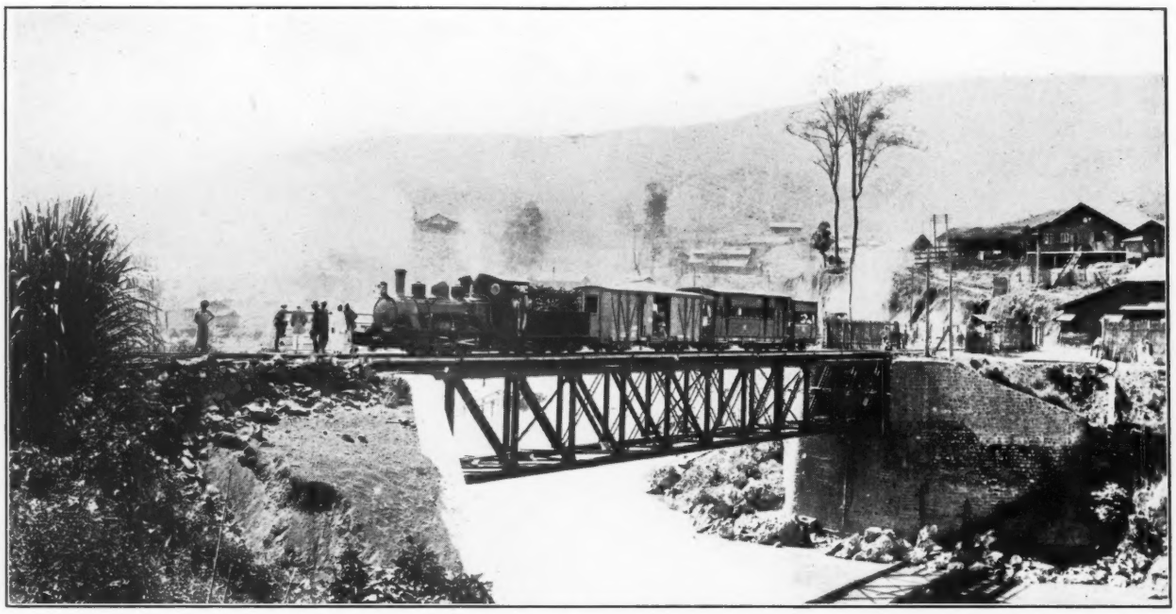
The Chinese mined ore 50 ft. below this level, but the amount of water must have been so large that they had to abandon these lower workings. To drain the mine for another 100 ft., it would have been necessary to drive a second long adit about three-quarters of a mile, and evidently this was more than the engineers would undertake, on account of the problem of ventilation, and more than the financiers would authorize, on account of the long time they would have had to wait to realize on the investment. All work was done by hammer and moil.

Previous to 1868 Bawdwin was a prosperous Chinese colony, with a population of 20,000, as evidenced by rec-

Ore bins at the portal of "Tiger Tunnel," Bawdwin mine

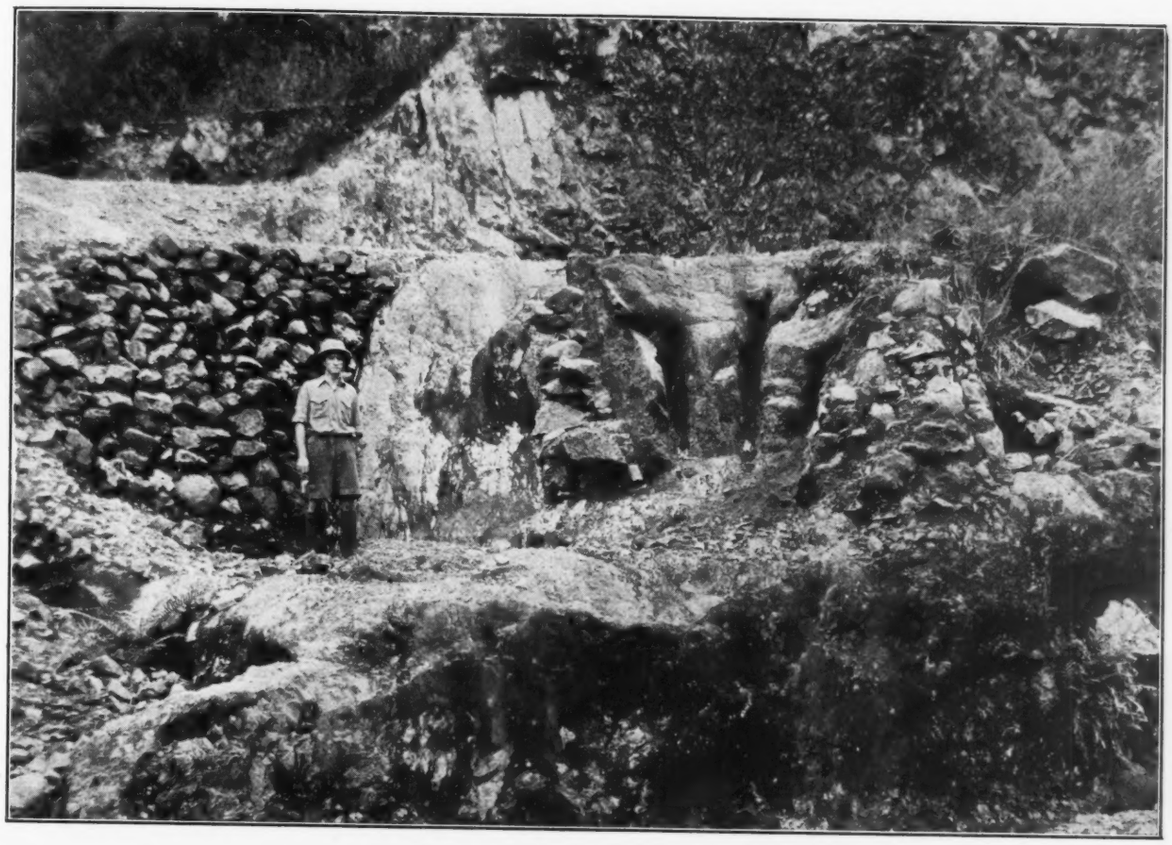


Portal of the tunnel, recently equipped with electric haulage

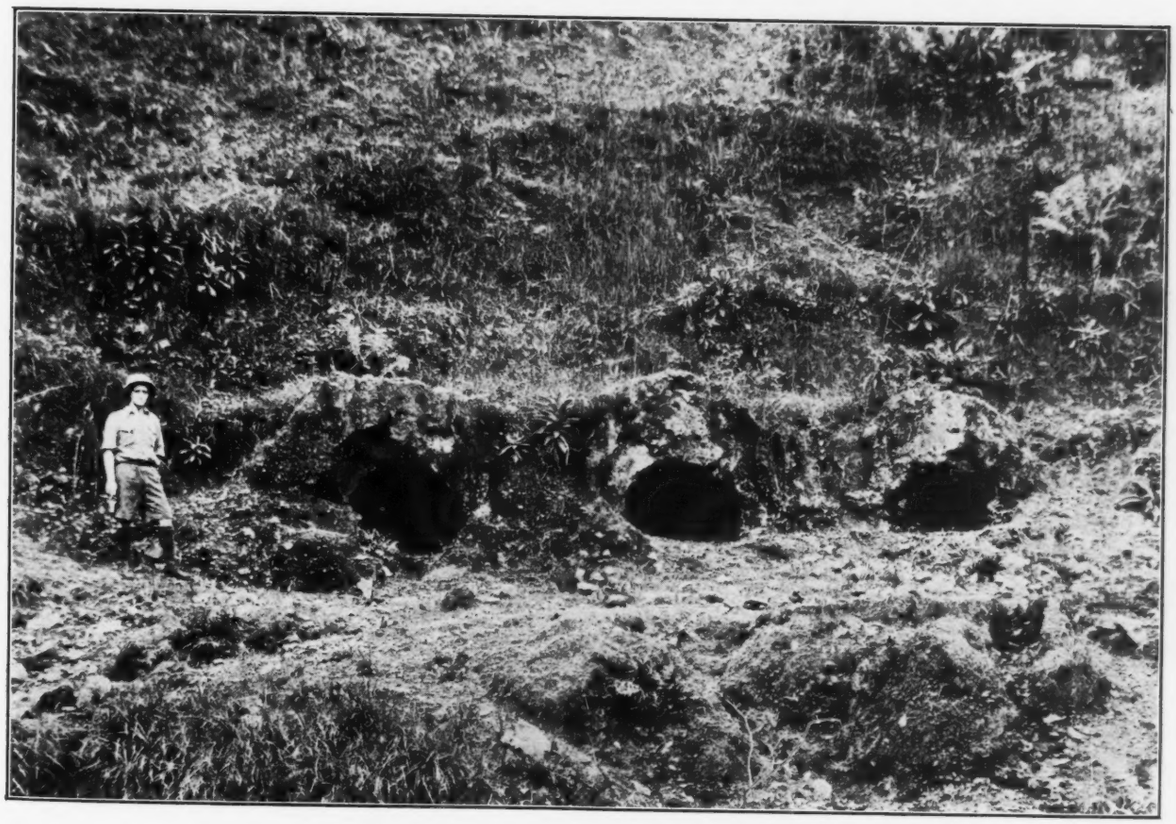


The bridge across the Namtu River, at Namtu

Remains of an old Chinese bridge at Bawdwin



Site of an old Chinese blast furnace at Bawdwin



What remains of three cupeling furnaces

The smelter at Namtu, showing roasters and blast furnaces

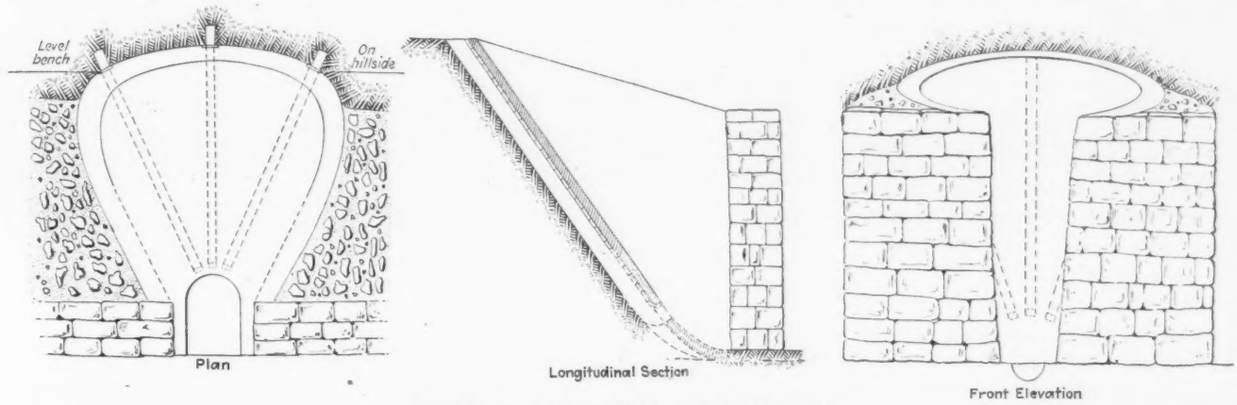
No. 3 blast furnace in course of repair

ords and remains of temples, mosques, theatres, and other public buildings and bridges and the thousands of graves that cover the hillside.

It is generally supposed, on account of various discoveries and inscriptions found in the neighborhood, that Bawdwin formed a penal settlement for the Chinese government. The entire workings are surrounded by many miles of entrenchments that parallel the mountain ridges. These fortifications are about 15 ft. wide and 10 ft. deep, and are situated on both sides of the mountain ridges that hem in the mine.

Few ladders were used, and those found were similar to the Mexican chicken ladder—simply a notched inclined log. On both sides of the portal of many of the adits are little niches, one or two feet square, similar to those found in Mexican mines, in which the Chinaman is supposed to have deposited his small Buddha or other lucky icon to ward off evil spirits. In all there are probably twelve or fifteen miles of these workings.

The method of timbering was ingenious. The drives being diminutive, only small timber was required, 5 or 6 in. in diameter being the maximum. This timber was



Details of ancient Chinese blast furnace

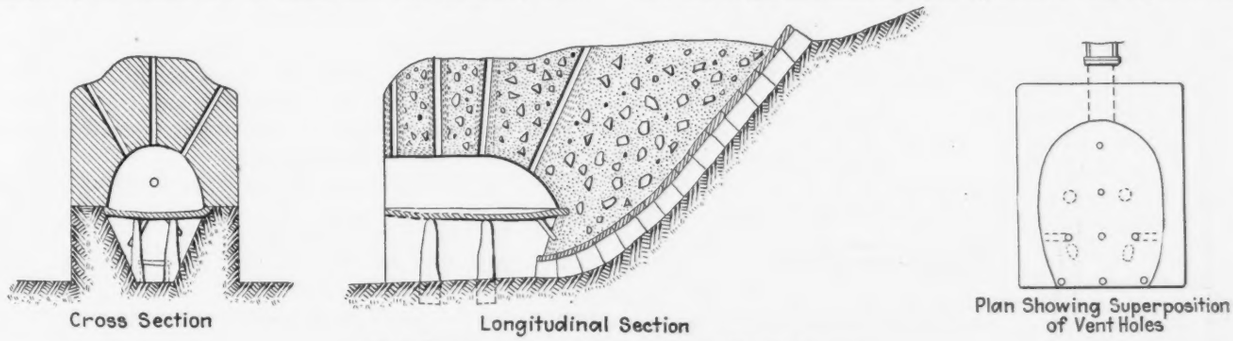
The present Chinese-Shan miners claim that soldiers lived in these entrenchments, and it is believed that the ones on the adjacent side of the mountains were to guard and keep in the prisoners, and that those on the opposite side were for the purpose of repelling attacks from wild marauding native tribes.

Early Chinese Methods

The Chinese worked the mine for silver alone, as the lead and zinc were evidently of no value to them. The hill containing the orebody is riddled with adits, the majority of which are so small that the ordinary European is compelled to get down on his hands and knees to pass through the tortuous workings. Nearly all these adits are on slight downward incline, probably to facilitate ventilation.

The drainage adits are larger and necessarily are inclined the other way. The incline shafts are also larger, and run on a grade that will permit the carrying of material to the surface without the use of a ladder. Several of the more important ones have steps cut in the solid rock, and one in particular is in the form of a spiral. This was to get the maximum vertical depth in the shortest distance and at the same time permit the coolie to walk up with his burden.

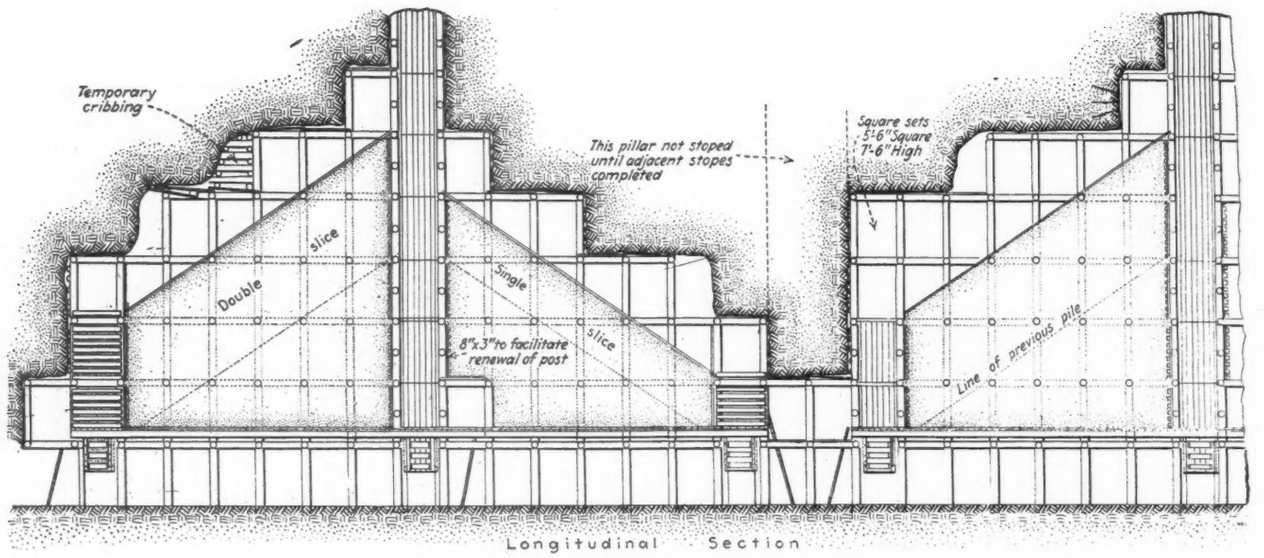
generally of pine or of "male" bamboo, the latter species of bamboo being almost solid, whereas the female has thin walls. There is no evidence of vertical shafts or of any mechanical equipment for hoisting. The method of stoping was not much different from present methods, except that the work was done on a smaller scale. On a new level ore was followed by a drift, and a raise was driven to the surface or to connect with workings above. The back of the drift was then stoped for a vertical distance of several feet; the ore was removed, and waste for filling was dropped through the raises or carried up into the stope in baskets. The operation was apparently a straight cut-and-fill system, the work being done within a small area and in a laborious manner. Stopes were carried only three or four feet wide, and when one section reached the surface or vertical limit of the stope, another drift was run parallel to the old one, and another stope carried up adjacent to the filled one. Probably more than 1,000,000 tons of ore was mined.



Details of ancient Chinese "cupeling" furnace

Chinese Smelted Ore for Silver Only

The ore was smelted locally in small furnaces, the remains of which are scattered for miles along the small river that runs through the property. In the beginning, the ore was smelted within a few hundred


Temporary cribbing
This pillar not stoped until adjacent stopes completed
Square sets 5'-6" Square 7'-6" High
Double slice
Single slice
8"x3" to facilitate renewal of post
Line of previous pile
Longitudinal Section

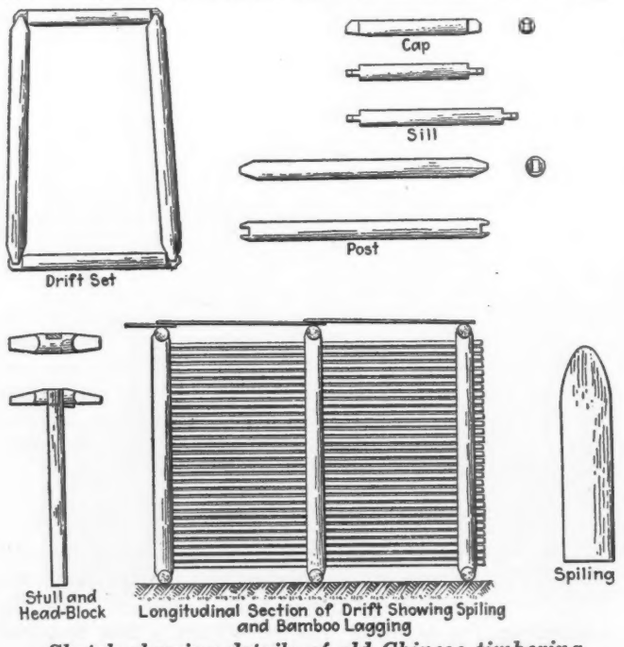
Square-set rill stope in the Bawdwin mine

feet of the mine, but gradually the supply of timber in the vicinity was exhausted to make charcoal; or perhaps the progenitors of our smoke farmers brought suit for damages. At any rate, it was found advisable to carry the ore to the fuel, and consequently the work was moved out along the river, with the result that the heaps of slag, so-called, can be found for miles along the stream.

The exact method of smelting is not thoroughly understood, but the results obtained in the extraction of silver compare favorable with modern smelting practice. A short description of the furnaces and the apparent method of procedure may be interesting to the smelter man. I leave him to draw his own conclusions.

Furnaces Were Excavated Into Banks

The blast furnaces were made by digging into a bank and making a crucible-shaped excavation flaring out at the top and open in front. Troughs for tuyères were cut in the back wall of the furnace and covered with flat stones. The front of the furnace was then built up of clay and boulders and the inside was plastered with several layers of fireclay, which completely sealed the long tuyères extending down the back to the bottom of the furnace. These long tuyères were evidently for the purpose of heating and conducting the blast to the bottom and narrow part of the furnace.



Sketch showing details of old Chinese timbering

The air was supplied by bellows or by the air pump that is still in use by the Chinese. These pumps were 8 to 10 in. in diameter and 6 to 7 ft. long, and were made by boring suitable logs. Inside a plunger was fitted, which was operated either by manual or mechanical power—usually a water wheel. Smaller pumps, up to 6 in. diameter, were made from bamboo. It is questionable whether these air pumps were operated by hand or by a water wheel, but as all furnaces were placed close to running water, I am inclined to think that water power was used.

The ore was first mixed with charcoal and roasted in small stalls and then carried to the blast furnace. Here it was again mixed with charcoal and, if necessary, according to the analysis of the sinter, a small quantity of flux was added before charging.

Samples of high-grade Bawdwin ore assay as follows:

Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	CaO, Per Cent	Al_2O_3, Per Cent	S Per Cent
45.4	47.2	21.2	0.2	5.0	3.2	2.0	1.0	20.5
44.1	46.8	21.0	Tr.	4.8	3.1	1.0	1.9	20.4

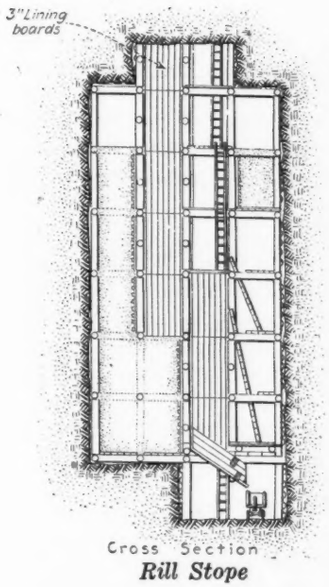
Sinter from the furnace assayed approximately:

Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	CaO, Per Cent	Al_2O_3, Per Cent	S, Per Cent
3.9	(a)44.5	18.9	0.2	10.0	4.5	2.3	4.8	3.2
2.5	44.9	16.5	0.3	12.0	4.5	2.9	3.1	2.1

(a) 2 to 3% of this was in the form of prills of lead.

These assays show that less than 1 per cent of the lead was actually reduced and collected in the lead well, but still sufficient to collect all but 2 or 3 oz. of silver. This small amount of lead was then ladled out and carried to adjacent banks of refining furnaces, where the lead was oxidized and silver recovered.

It is questionable whether the smelting operation was continuous or intermittent, as no evidence has been found on the property to warrant a conclusion. If it was continuous—and I am inclined to think it was—batches of freshly roasted ore and charcoal were added inter-



Rill Stope

mittently, and as the mass at the bottom became sufficiently plastic to give up its silver, it was scraped out in the form of a sticky sinter or "slag," and the charge was allowed to settle. If the process was intermittent, as maintained by some who have seen the work in China, the furnace was cleaned out of its former charge, the small opening in the front wall of the furnace was torn down and the sintered mass was scraped out ready for another cycle.

In the Bawdwin ore the silver is associated with the galena and not with the sphalerite. For every 1 per cent lead there is approximately 1 oz. of silver. The Chinaman had no use for the lead or zinc; consequently, he reduced the minimum amount of lead to collect the silver. It is almost inconceivable that with such crude furnaces the charge and blast could be so regulated that the sulphur would be reduced to 2 or 3 per cent, while, at the same time, only a few per cent of the lead would be reduced. The sinter carries 2 or 3 per cent prills of lead, and it was probably in them that the loss of most of the silver occurred.

Lead Was Cupeled on Mud "Test"

The refining furnaces were also built in a bank of earth, in rows of seven. The furnace was divided by a 2-in. "test" into two parts, called the top and bottom compartments. In the top compartment was placed the silver-laden lead. Extending vertically through the top of the furnace were a number of flues. At the back of the lower compartment was a large flue that extended up through the ground at the back to the surface.

The method of operating these furnaces was probably as follows:

A charcoal fire was placed upon a grate supported just above the test. The grate bars were made of fireclay, moulded in bamboos of 2 in. diameter, and then burnt. The door of the lower compartment was regulated to allow sufficient air to pass through and under the test (to keep it at the proper temperature) and thence up through the back chimney.

Sufficient heat was maintained upon the top of the molten metal to oxidize the lead. It is said that one man by rolling an iron rod over the molten metal could attend to the skimming of a series of seven of these furnaces. By this process of skimming and oxidization pure silver was obtained.

Evidently the fumes from all the smelting and refining furnaces had a tendency to prevent reforestation on the steep hillsides that had been cleared of semi-tropical jungle, as there are now no trees within three or four miles of Bawdwin and the hills are covered with a grass that grows three or four feet high, and which is burnt off every year. It is an ill wind that does not blow someone good. On account of the clearing of the forest by the Chinaman and the effect of the fumes, Bawdwin is one of the comparatively healthful places in Burma. As no rank vegetation can now get a start on the hills, there are no places in the vicinity in which mosquitoes can breed.

Europeans Became Interested in 1904

Burmese brought the attention of Europeans to these enormous slag dumps, and, in 1891, A. C. Martin, of Rangoon, visited the property and took some samples. With J. Sarkies, also of Rangoon, he formed a partnership and applied for a lease of four square miles. Nothing was done for several years, until Mr. Martin met Captain M. F. Kinderley in Mandalay. Together with Mr. Sarkies and Maitland Kinderley, a brother, they formed the Burma Mines Development & Agency Co., of which the Burma Mines & Smelting Co. was a branch. In 1904 the company was reorganized as the Great Eastern Mining Co., and Lord Hersey became identified with it.

The local directors in Rangoon consisted of Mr. Sterne, Captain Barnett, S. W. Watts, A. C. Martin, and W. A. Freymouth.

In 1906 this company sold its right to the Burma Mines Ry. & Smelting Co., and in 1908 changed its name to Burma Mines, Ltd. At this time there was no intention to work the mines, but only to build a railroad and smelt the Chinese slag.

First Smelter at Mandalay

A narrow-gage (24-in.) railroad, forty-five miles long, was completed to connect with the government line, and a smelter was built at Mandalay, 169 miles away. Smelting actually started in 1909. No money was made, as the railroad haul was too great, and in 1911 a new smelter was built at Namtu, on the narrow-gage line, only twelve miles from the mine.

After 200,000 or 300,000 tons of slag had been smelted, the engineers began to consider the probability that the Chinaman had left some ore, so they started to prospect by cleaning out the old workings. About this time Herbert Hoover secured control of the mine and became chairman of the board. After two years of difficult and discouraging work, the main orebody was tapped by what is now called the "Dead Chinaman" tunnel, or the 171 level.

This adit was well below the main workings, although some of the Chinese stopes had actually reached a vertical depth of 50 ft. below this level.

From then on the development was rapid, and today the "Chinaman" orebody is considered to be one of the largest high-grade silver-lead-zinc orebodies in the world. The total ore reserves on Jan. 1, 1921, were:

Tons	Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent
4,429,458	23.3	25.3	17.7	1.2

Of this only a little over one-tenth is designated as probable ore. No mineral with a content less than 20 per cent lead and zinc is considered, except for part of 335,681 tons of copper ore, which averages Ag, 23.2 oz.; Pb, 12.8 per cent; Zn, 7.7 per cent; Cu, 11.0 per cent.

The mine probably contains another million or more tons of low-grade material, carrying between 8 per cent and 20 per cent combined lead and zinc, which has not been taken into consideration as ore. The ore occurs as solid masses of sulphide, with little admixture of gangue. On some levels the solid ore will average 50

ft. wide for a continuous distance of 1,000 ft. along the strike, and in a few places it is 100 to 140 ft. wide. Many of the blocks are 75 per cent solid lead and zinc sulphide.

The present bottom of the mine is the 653 level, which shows what was once a continuous orebody over 2,000 ft. long, but which has now been faulted into two separate blocks, with a displacement of over 600 ft. along the throw.

The mine has been systematically developed down to the 653 level, or main adit, known as the "Tiger Tunnel," which is about two miles long. This adit is double-tracked for 7,400 ft. from the portal to the main internal shaft. No expense has been spared in developing and equipping the mine in the most up-to-date manner. Notwithstanding labor is cheap, machinery is cheaper, and little hand work is done.

Development Has Been Systematic

The "Chinaman" orebody is blocked out by crosscuts through the ore at 100-ft. intervals; these are placed vertically above each other on the respective levels. Raises have been driven from these crosscuts to make continuous passages from the top of the mine to the lowest level. The same raises are alternately used for passing ore or filling, and are so offset on every level that ore or waste can be drawn out at that level or passed through to the next or to the lowest level.

All ore goes straight through to 653 level, where it is loaded into four-ton cars and hauled in trains of ten cars by electric locomotives to the tipple plant. Waste filling is obtained from the surface by quarrying around the raises so that the filling will go directly into stopes without further handling.

A modified square-set rill system is used in stoping. For this system it is advantageous to lay out the main drift in the foot-wall country rock and to crosscut through the ore at 100-ft. intervals to the hanging wall. In these crosscuts are the main rises.

The 50-ft. blocks on either side, with the exception of a 12-ft. pillar directly over the crosscut, comprise the stopes. These rill stopes have their apexes at the main passes and slope down to the stoping crosscuts. In the early work no pillar was left at the toe of two stopes and one ore chute sufficed for two stopes. This section would become excessively heavy, and it has been found desirable to leave a 12-ft. pillar between the two stopes and carry up individual ore chutes.

Stoping Starts on the Hanging-Wall Side

Stopes are carried three or four sets wide, depending on the character of the ground. Four sets is the maximum width that the best ground will stand, and as the ground becomes heavier the stope is brought in to three or sometimes two sets wide; the length remains the same. Where the vein is wide the hanging section is taken first, and when completed a second section is taken alongside, retreating toward the foot wall. Under this arrangement the crosscuts and drifts are always in solid ore or rock and the part under the old stope can be filled, thus minimizing expensive repairs, through old stoped areas. To get the proper rill, square sets must be of the proper size and height. Those in the Bawdwin mine are 5½ ft. square and 7⅓ ft. high.

The manways are on the hanging-wall side of the chute, and not along one side, as is generally the custom. This gives access to either stope from the manway or chute without blocking either.

As the train of four-ton cars leaves the portal of the tunnel it is hauled to the tipple plant, where four four-ton cars are emptied at once. From the tipple plant the ore is carried by a 20-in. belt conveyor and discharged into bins by an automatic tripper. From the bin the ore is taken by trains to Namtu, seven miles away, where are situated the mill, smelter, and headquarters of the corporation.

Mining Operations of Nevada Consolidated in 1921

According to the annual report of the Nevada Consolidated Copper Co., operating at Ely, Nev., the most important feature of 1921 was the development of additional tonnages of high-grade direct-smelting ore along the margin of the Ruth concentrating orebody. Fully developed direct-smelting ore estimate as of Dec. 31, 1921, is 406,196 tons, averaging 7.27 per cent copper. In segregating ores, 3 per cent copper was assumed as the lower limit of direct-smelting grade. No additional ore was added to the disseminated porphyry reserves during the year, the total on Dec. 31, 1921, amounting to 63,401,209 tons, averaging 1.58 per cent copper.

Steam-shovel mining costs of concentrating ores, exclusive of depreciation and Federal, state, and local taxes, but including all other overhead expense, were as follows:

	Cents per Ton Ore		Cents per Cu. Yd. Capping	
	1921	1920	1921	1920
Drilling and blasting	6.45	6.14	11.26	8.78
Steam-shovel operations	2.77	3.04	5.78	5.90
Locomotive tramming	7.69	8.61	18.23	18.75
General pit expense	1.78	2.50	1.25	0.96
Miscellaneous	9.42	9.81	4.71	6.08
Totals	28.11	30.10	41.23	40.47

Steam-shovel efficiencies were as follows:

	Tons of Ore Per Eight-Hour Shovel Shift	Cu.Yd. Capping Per Eight-Hour Shovel Shift
1918	1,404	952
1919	2,254	1,155
1920	2,255	1,187
1921	2,392	1,148

Ruth mine underground costs showed improvement as follows:

	Cents per Ton	
	1921	1920
Branch raises and sublevels	22.35	24.12
Undercutting and caving	18.05	17.94
Tramming	6.23	7.94
Hoisting	4.60	6.11
General underground upkeep	18.81	24.36
General mine expense	7.02	7.08
Miscellaneous	8.63	9.65
Totals	85.69	97.20

Improved labor efficiencies are also reflected in the following figures:

	Dry Tons per Man-Shift Underground	Dry Tons per Tota Man-Shift on Ruth Mine Payrolls
1918	10.39	7.53
1919	11.51	8.34
1920	12.27	8.99
1921	13.08	9.38

In comparing costs and labor efficiencies, it must be remembered that operations in 1921 were confined to the three winter months, with the weather persistently cold.

After the shut-down small crews were organized to proceed with alterations and additions to plant which could not be economically accomplished when operating, as well as to maintain the plant in condition for reopening. No carbonate ore was extracted during the year, and the mine dump storage remains at 80,229 tons as at the close of 1920. The shovel pits furnished 64.8 per cent of the ore mined during the year.

Development of Metallurgical Practice at the Hollinger Mine

Early History of the Enterprise—The Original Mill — Amalgamation vs. Cyanidation — Treatment of High-Grade Ore—Development of Present Practice

By P. A. Robbins

PRIOR TO THE DISCOVERY of the Hollinger, no gold mine had been successful in Ontario. For twenty-five years many unsuccessful mines had been started in Hastings County, and the Thunder Bay, Lake of the Woods, and Sturgeon Lake districts, and many mills had been built. The standard milling practice was the use of crusher, stamps, plates and vanners, with possibly a 65 to 70 per cent recovery from a $10 ore. The Timmins-McMartin-Dunlop Syndicate (owner of the Hollinger mine) was without experience in mining except for its one successful venture with the La Rose mine, at Cobalt, where by rough hand sorting, carloads of ore carrying 3,000 to 6,000 oz. silver per ton were shipped from surface trenches.

A nephew of the Timmins brothers, Alphonse Paré, a recent graduate from McGill University, was in charge of the Hollinger during its first fourteen months of life, and to test the Hollinger ground had installed a two-stamp Tremain steam mill and a jaw crusher, which were in operation when I took charge of the property at the beginning of 1911.

As the mill had a limited capacity, only the best ore from the shaft and drifts was being treated. The recovery from one plate, about 4 x 12 ft., was about $30 per ton, and the tailing carried $20, thus indicating a gross $50 content. The selection of the best ore was not to mislead; it was logical to get as much gold as possible to help pay expenses. The results no doubt led the owners to believe that the vein would carry from $40 to $50 per ton. Subsequent sampling showed this particular orebody to average $35 on the surface and $31 on the 100 level over a length of approximately 950 ft. and an average width of 10 ft.

Because of the satisfactory results obtained, the owners decided (as a separate company) to erect a thirty-stamp mill to treat Hollinger and custom ore. Tom Scanlan, a mechanical engineer of wide experience in smelter and mill work with the Allis-Chalmers company, had been engaged to design the plant. Mr. Scanlan adopted the standard practice of California and the various ill-fated Ontario projects, and ordered the parts for a thirty-stamp mill, with crushers, plates, Overstrom sand tables, and Johnson vanners. These parts were ordered before the mill was designed, as it was not possible to bring in machinery except in midwinter, when the forty miles of swamps, lakes, and rivers were frozen over; to get delivery in the winter of 1910-1911 the orders were hurriedly placed by Mr. Scanlan in the fall of 1910.

This was the status of the work when I was engaged to take charge in January, 1911. Without losing a whole year I could not undertake to run ore tests and redesign the mill for cyanide treatment if found advisable, and hence we decided to put up an experimental mill, with the stamps in a separate building, leading the pulp off on one side to a light shed containing the plates and concentrators. This would leave the space in front of the stamps for a cyanide plant to be erected later. Work on this mill was well under way when on May 19, 1911, a forest fire swept the property and burned everything. Later fires in June and July cleaned up the remainder of the district and destroyed all possibility of building the mill in 1911.

A. G. Kirby, who was in charge of the Nova Scotia mine, at Cobalt (fresh from the new Goldfield Consolidated mill), was engaged to run a series of tests on the ore. I sent him, as a test sample, ore carrying $50 per ton. Rumors were in circulation that the Hollinger was a frost and that the fire had been inspired. When the test sample ran $50 per ton it was believed that we were trying to sell stock. The facts were that I knew we had much high-grade ore, and I wanted a mill to recover the gold in that ore. The treatment of $10 and $12 ore did not worry me, but when it came to ore carrying $80 to $100 per ton, I wanted to be sure of results.

Concentration Generally Favored

Mr. Kirby's tests showed poor recovery by amalgamation, but cyaniding and concentrating gave 99 per cent plus when the ore was all slimed. As a result of Mr. Kirby's work, I decided to crush in solution and aim for 70 per cent through 200 mesh. The matter of concentration was given much thought, and though we felt that concentration could be omitted, we were worried about the frequent occurrences of ore carrying $100 or more per ton. I finally decided upon concentration for the following reasons:

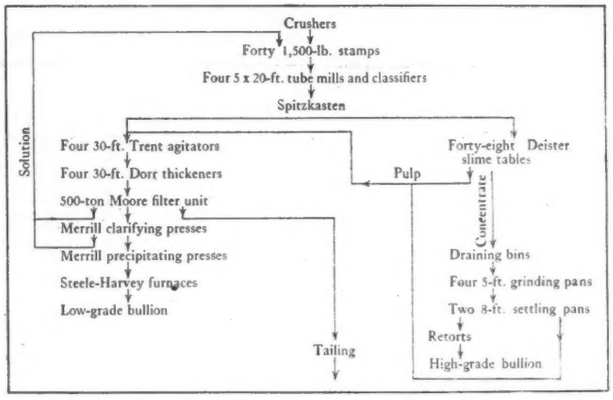
1. The tables would catch the gold-bearing sulphides and gold flakes that escaped from the tube-mill circuit.
2. The taking out of heavy particles by concentration would make it possible to do less fine grinding than otherwise.
3. The separate treatment of concentrates would enable the lower-grade pulp to be passed on with a minimum of agitation.
4. Refinery practice would be simplified; there would be less precipitate to treat.

With each addition to the Hollinger mill, I consulted the mill superintendents, and every one of them unreservedly declared himself in favor of retaining concentration as a part of the flow sheet.

The decision to crush in solution and not use plate amalgamation was based upon a belief that free, amalgamable gold would readily cyanide. I did not believe the argument that a mill which recovered 95 per cent was losing 5 per cent of all the gold in the ore, and that, therefore, the gold recovered by plate amalgamation indicated a 100-per cent recovery for that gold instead of a 95-per cent one. My belief was, and still

is, that any gold that will amalgamate freely will readily cyanide and yield approximately 100 per cent. The losses are in the gold occluded in the sulphides and in the gangue particles, which will not amalgamate.

In plate amalgamation there is often, perhaps usually, the indeterminate loss by theft of amalgam; and the possibility of such loss occurring is so great that it outweighs any hair-splitting metallurgical arguments in favor of plate amalgamation. Having decided upon the important steps (all sliming, crushing in solution, concentration, and separate treatment of the sulphides), we proceeded to design a mill for treating 400 tons per day, and the following flow sheet was adopted:



Flow sheet first adopted at the Hollinger

Crushers were one No. 7, followed by one No. 5 gyratory, with provision for a second No. 5; belt conveyor from crusher station to mill and distributing belt over bins; Nelson feeders to forty 1,500-lb stamps; one 5 x 20-ft. tube mill to each ten stamps; tube mills and classifiers in closed circuit; overflow from classifiers to spitzkasten; underflow from spitzkasten to concentrators, overflow to Trent agitators; concentrate to drainage bins; table tailing to Trent agitators; discharge from agitators to Dorr thickeners; underflow from thickeners to Moore filters; overflow from thickeners to battery storage tanks or to precipitation if desired; filter pregnant solution to precipitation; barren solution wash to battery storage; cake to waste.

Why Certain Machines Were Adopted

The decisions to use Trent agitators, and pan grinders for concentrate, were based upon Mr. Kirby's Nevada experience. Deister tables were used for concentrating because of the excellent results which Kirby and myself had obtained with these tables at Goldfield Con., and at the McKinley-Darragh mine, in Colbalt, respectively. The Moore filter was adopted because of the Moore-Butters litigation. If Butters won we would be safe, for he was not the plaintiff. If Moore won we would be on the winning side. Furthermore, the Moore people needed money, and I was able to negotiate a deal at 10c. per ton royalty, paying in advance the estimated royalty for four years and thus doing away with further royalties. We also had the additional right to increase the plant from time to time upon the same basis. This seemed to be good business, and besides metallurgical advantages was one of the reasons for adopting the Moore system.

The mill was started July 1, 1912, and was tuned up on waste rock, followed by $10 ore for a week or so. After about two weeks of this preliminary work, $20 ore was treated, and everything seemed to be running as well as could be expected. The concentrate treatment plant was continuous in operation. Concentrate was shoveled into the grinding pans, which discharged into the settlers, from which the continuous stream of mercury flowed to the amalgam safes, being strained through canvas bags. The concentrate assayed $350 to $400 per ton, and about eight tons per day was being treated.

Then came the first clean-up. About fifty flasks of mercury was in the system. This was retorted. No gold! No gold in the safes; no gold in the grinding pans. The total yield should have been about $40,000; it was exactly $9.40. I still have the button, and have named it *"Nil desperandum."* A quick clean-up of the precipitation presses disclosed that the gold was not lost; it was in the presses. It was immediately evident that the cyanide in the concentrate was preventing amalgamation.

In Mr. Kirby's tests the concentrate had been thoroughly washed before amalgamating, whereas in the mill we relied upon draining to get rid of the cyanide. The cost and delay of remodeling the amalgamation plant so as to wash the concentrate presented a serious problem; we were heavily in debt, and our treasury was almost empty. It was therefore decided to try cyaniding the concentrate, and a 10-lb. solution was used in the pans and settlers, which now became agitators. The plan worked beautifully. Thus the amalgamating plant, without appreciable alteration, became a cyanide plant, and continued in use until it became too small for the increased tonnage of later years, when the pans and settlers were converted into Dorr thickeners for use in the new concentrate treatment plant, and thus nothing was lost.

Difficulties Were Numerous

Meantime the Trent agitators had been giving trouble. So unreliable had they become that a gong had been hung conveniently near, and when the man in charge would see an agitator stopped or threatening to stop, he would pound upon the gong, and all hands would rush to the rescue. Each agitator had been embellished with a set of grappling hooks and lines; these were dropped into the agitator when necessary, the arms engaged, and then for hours, and sometimes days, a gang of men would walk steadily around the tanks, dragging on the grappling lines and thus keeping the mill going. We did everything we could think of to make these agitators work, but they would not. An inherent trouble was that the sands would segregate and classify out, and build up until they stopped the apparatus from working.

Fortunately, our filter capacity was greatly in excess of our requirements, and by forming the cake slowly we could use the loading tanks as agitators. Later we equipped two conveniently located solution-storage tanks with Dorr agitators and were able to discard the Trent apparatus and convert the tanks into thickeners. The original mill had been designed for 400 tons per day, but by the end of the first year we were treating 650 tons per day.

The spitzkasten that fed the tables were constantly giving trouble; they were replaced by eight 13-ft. diameter Dorr thickeners, to fit the space available. The Dorr classifiers were overloaded in more ways than one.

Considerable experimenting had been necessary before the closed-circuit system of tube mill and classifier was arranged satisfactorily. The slope of the classifiers had been increased and the length had been doubled, so that they would discharge into the tube mills and the tube mills discharge into the classifiers. This greatly overloaded the driving mechanisms. The tonnage had been increased to 60 per cent over the designated capacity, and the classifiers had been speeded up; but they worked, although the breakages were a constant source of worry to the Dorr company.

In 1913 the demand for increased tonnage led to the installation of twenty more stamps (making sixty in all) and two more 5 x 20-ft. tube mills, making a total of six. More concentrating tables were not purchased, as it had been found that clean concentration was not necessary and that those in use could handle the increased tonnage satisfactorily. The Moore filter unit had been designed to treat 500 tons daily, but gradually the tonnage was raised to 750, and with satisfactory results. The mill had been whipped into shape by Noel Cunningham, who not only possessed unlimited nervous energy, but had faith in the apparatus under his care; he made things work. We were running with insufficient agitation, which kept the tailing higher than it has been since, but the mine was developing rapidly into a big enterprise, our debts were paid off, large dividends were being disbursed, a six months' fight with the Western Federation of Miners had been won (Nov. 15, 1912, to June 1, 1913), and we were doing more satisfactory work than the other mills in the district. In fact, the Hollinger mill was the only one that did not find it necessary to shut down and remodel; and, except for the change from amalgamation to cyanidation of concentrate, the Hollinger mill has not changed its process. The Vipond, Porcupine Crown, McIntyre, and two smaller properties all tried plate amalgamation and all found it neessary to resort to cyaniding. The Dome mill was remodeled to substitute sand leaching for part of its process—a change of doubtful value.

Up to the end of 1914 I had considered the mill as experimental, and it had been my intention to sink two main shafts (as our knowledge of the property increased) and erect a 4,000-ton mill between these shafts. But my directors were lacking in the necessary faith to put up the $1,500,000 required, and so the dream was never realized.

Counter-Current Decantation Adopted

By the end of 1914 the development of the Acme mine (now a part of the Hollinger Consolidated) made a large increase in milling capacity imperative. Dorr had experimented at the Ophir with Nichols counter-current decantation, and C. H. Poirier had altered his mill at the Vipond mine (Porcupine) and was using this system. M. W. Summerhayes and S. W. Cohen had investigated the system and were putting it in at the Porcupine Crown. R. J. Ennis was falling in line with the McIntyre mill after he and André Dorfman had satisfied themselves that the scheme was satisfactory. As a result of Poirier's work and the opinions of the others I decided to try out the system.

The Vipond had allowed 4 sq.ft. of tank bottom per ton per day, but this was proving too little, and so we allowed 6 sq.ft. The 1914-15 addition to the Hollinger consisted of forty 1,500-lb. stamps, four 5 x 20-ft. tube mills and classifiers, sixteen double-deck Deister slime tables, and six 25 x 14-ft. Dorr agitators. To make room for the agitators, we converted the old slime tables into double deckers, thus saving half of the table space. The counter-current decantation plant consisted of two rows each of four 40-ft. Dorr thickeners. The Dorr company recommended five steps, but the fifth step did not seem necessary with cyanide at 13c. per lb. and zinc dust at 7c.—the prices then prevailing. We did not abandon the Moore filters, as they were economical and suited for handling colloids.

In the Hollinger section, after tube milling we decanted a muddy solution and settled this in eight 30-ft. thickeners. The overflow from these went to storage or precipitation as desired. The underflow went to agitators; most of this pulp went to the filters, but any excess flowed to the counter-current decantation vats. By this method we treated most of the Hollinger flocculent ore in the filters and were thus able to force a large tonnage of granular ore through the counter-current system. The Hollinger and Acme not having been consolidated, we operated as two mills under one roof from about March, 1915, to June 1, 1916.

Bullion Melted with Lead and Cupeled

Before going on with the story of the mill, this is a convenient place to deal with the refinery. Originally we expected to recover most of our gold by amalgamation, and retorts had been installed for treating the amalgam. The precipitate from cyaniding was to have been melted in pots in Steele-Harvey furnaces; then fluxed and a low-grade bullion shipped. The failure of the amalgamating plant left us with improper refinery equipment. I immediately asked Henry Hanson (then with the Merrill company) to design for us a refinery similar to that of the Pittsburg Silver Peak, at Blair, Nevada.

The plan prepared by Mr. Hanson consisted of a lead stack, for melting the precipitate fluxed with litharge, borax, silica, and iron, from which a lead bullion was produced. This bullion was then cupeled, the lead being recovered as litharge. The bullion produced was 980 fine. The process was a success from the start, although many little refinements were introduced from time to time, such as granulating the litharge under water.

We started briquetting with the idea of drying the briquettes, but we had great difficulty in mixing the precipitate and fluxes. The borax would cause the mixture to set in chunks. A small brick clay-mixer was purchased in the belief that it would squirt out a hexagonal stream of mixed flux and precipitate, but it would not squirt. Oil was added to assist in the operation, but without success. It was found that this pug mill, working without the die, discharged the material in flat blobs, which immediately set hard enough to be handled with a shovel. So the refinery operation resolved itself into a simple process: The precipitate was dried in the presses by air; the presses were cleaned into side-tipping mine cars. The cars were tipped onto a mixing plate, and a rough mixture of the flux was shoveled into a pug mill, which wormed out a series of blobs, a little fuel oil being used as a binder. These were charged immediately into the lead stack without drying or briquetting. No dusting occurred. The lead bullion was cupeled as fast as produced, and in thirty-six hours the campaign was over. As a check on losses

in fume from the chimney, several times we collected all the top snow within a radius of 50 ft. of the refinery, but could detect no gold.

This brings us up to 1916, when plans were made for consolidating the Hollinger, Acme, and Millerton properties and doubling the capacity of the mill. The consolidation took place Jan. 1, 1916; but, owing to an ambiguity in the wording of the Dominion War Tax measure, the actual physical consolidation was held in abeyance until June 1, 1916. Meanwhile the plans for increasing the mill were under way. With three and one-half years' experience we felt satisfied with the results being obtained, but we were open to suggestions and anxious to learn the truth about proposed innovations.

Belt vs. Bucket Conveyors

The Hollinger ore had been handled on belt conveyors from shaft to mill, a distance of 360 ft. Acme ore had been handled in balanced buckets running on wire ropes over a distance of 840 ft. The Acme plan cost less per ton over 840 ft. than did the Hollinger plan over 360 ft. Moreover, the Acme costs were saddled with the expenses for repairs and alterations necessary to bring the system into smooth working order. We decided therefore to convey ore from the new crusher station to the mill (about 1,100 ft.) in balanced skips, running on a trestle.

Ball mills were being used at the McIntyre and Vipond mills and were being installed at the Dome. The Michigan copper and Western porphyry mines were going strong for ball mills. From the figures available I could not see the possibility of effecting an economy by their use; the cost of operating stamps invariably figured from 3 to 4c. per ton cheaper. Then, too, I knew something of the reasons for the adoption of ball mills by our neighbors.

The McIntyre company started with ten stamps, plates, and vanners, but later Chilean mills were put in. It was found impossible to get the tonnage through the mills; ore and cash reserves were at a low ebb. In the emergency, a certain manufacturer supplied ball mills on credit. New ore was discovered; both mine and mill proved a great success. But the reasons were financial, not metallurgical, which led to the adoption of ball mills. Further, the McIntyre was then working in a soft porphyry, which could be crumbled in the hand.

The original five tube mills at the Dome plant gave insufficiently fine grinding. C. D. Kaeding, newly appointed general manager, desired greater crushing and finer grinding. The company was not in a condition to stop the mill and reconstruct, nor were funds available for building an extension to the mill. By tearing out the stamps and installing ball mills, Mr. Kaeding could squeeze a plant with a large crushing capacity into the existing building. These were the reasons given by Mr. Kaeding to me at the time. He was after gross results, not metallurgical perfection.

I had installed an 8-ft. tube mill of a well-known design at the McKinley-Darragh, at Cobalt, and had found that in operation there it required three times as much power as was claimed by the seller, so my faith in claims made by the maker was strained. For some time I had tried to get from him the test results of ball mills, but could never get a complete set of tests from any one mill showing power, iron consumption, and grinding results. However, we proceeded to design our new mill, and we made up two complete sets of plans, one with stamps, the other with ball mills. In the midst of this work the manufacturer of the ball mills agreed to loan me a mill for test purposes. An 8-ft. mill arrived about six weeks later. We promptly set it up and got it ready to run, then discovered that the liners would not fit. Another delay of some weeks occurred before new liners arrived. The mill was started, but the scoop feeder would pick up only 250 tons per day. Another delay occurred before a feeder with three scoops arrived. This was promptly put on, and the mill started, when we discovered that the throat of the feed trunnion would not pass the ore. I communicated with the makers and learned that the trunnion would have to be changed, as it was not designed for large tonnages.

All this consumed much time, and it gradually dawned on me that the manufacturer was not showing great eagerness to have his mill submitted to a ruthless test. Meanwhile we had erected separate bins and installed two 6 x 16-ft. tube mills, classifiers, and crushing equipment for this test plant, and we wanted information.

I bought a 48-in. Symons disk crusher and a 7 x 5-ft. cylindrical ball mill. We tested the Symons machine. It did excellent work on dry ore and delivered a uniform product about the size of coffee beans; but much to our surprise the tube mills quickly choked on this product and we could not grind it except at a slow rate. The Symons machine was set aside to be used as a preliminary grinder in a scheme for the continuous sampling of the discharge from the main crusher station. The cylindrical ball mill was next set up and tested, but it was not as economical as stamps, and so we decided upon the latter.

I believe that, in a 50- or 100-ton plant, a ball mill is the better; but in a mill of sufficient size to employ a staff of trained battery men, the decision between stamps and ball mills should not be made lightly. The mill men like the ball mills because of freedom from noise and ease of operation; but this freedom would have cost an extra 3 or 4c. per ton at the Hollinger plant.

Shorter Tube Mills of Larger Diameter Installed

The original mill had 1,500-lb. stamps and 5 x 20-ft. tube mills, and the combination gave us about 16.5 tons per stamp per day, 70 per cent through 200 mesh. We had found that the tube mills were the limiting factor. By loading a mill with manganoid (steel) pebbles we were able to get a duty of twenty to twenty-two tons per day per stamp.

I had engaged J. N. Bulkley, of Johannesburg (then in New York), as consulting engineer on our mill and hoisting problems. Mr. Bulkley had just finished his work with the New Modderfontein mill, in the Transvaal. Guided by his advice, we had installed in our test plant, before mentioned, two 6 x 16-ft. tube mills, with roller supports on the discharge ends, and 42-in. discharge openings. The pebble consumption in these mills was three times as great per ton treated as that in the 5 x 20-ft. mills, and the power consumption was much more. On the Rand the pebbles used are selected pieces of ore, so a high pebble consumption is rather an advantage, but the Hollinger quartz is so brecciated that imported pebbles must be used, thus making low pebble consumption necessary for low costs.

The large discharge opening drained the moisture from the mill. A tube mill works better when it has a small discharge, thus impounding the pulp and forming a pool from which floats the material that is ground fine enough for discharge. The roller supports gave much trouble, so we scrapped the rollers and put in trunnion heads with small discharge openings, and got fairly good results, except in the matter of pebble consumption. As a result of this and other experimental work we decided that a 5½ x 16-ft. tube mill would probably give us the increased capacity required. We did not test a 5 x 22-ft. mill, as there are in existence a number of published tube-mill tests that do not show increased advantage in the use of long cylinders. I never had the opportunity to find out what these 5½ x 16-ft. mills would do, as war conditions grew steadily worse, and although I built the new mill, it stood idle during my stay at the Hollinger, which I left on Oct. 4, 1918.

The remainder of the flow sheet was carried out as established by previous practice. The Dorr company had developed the tray thickener, so the area of our thickening plant was made 50 per cent smaller than would have been required if single tanks had been used. In the old mill we used Merrill clarifying presses, but trouble was experienced in cleaning them. After introducing montejus for blowing the wash water into the presses at 100 lb. pressure, we obtained better results. In the new mill we constructed clarifying vacuum filters of the leaf type; these could be inspected and cleaned with wire brushes or sand blast when necessary. The concentrate treatment plant was designed to repeat the previous work, 4 x 16-ft. tube mills being used for grinding. The strength of solution, however, had been lowered to 5 lb. potassium cyanide per ton of solution in the concentrate circuit.

As a result of our work I am firmly convinced that stamps are more economical than ball mills on the comparatively hard ore of the Hollinger, and that crushing in solution and sliming is superior to crushing in water and amalgamating, then dewatering and cyaniding. Between filtering and continuous decantation, I believe that filtering is more economical. Our decision to use decantation was influenced by a 10c. royalty charge against the filters. Cyanide was being bought at 13c. and zinc dust at 7c. per lb.—figures that favored the adoption of decantation. Even with this I could never figure any economy in the decantation plant except in the simplicity of operation. The decantation plant must be charged with the increased cost of pumping the larger quantities of solution, the extra zinc dust for precipitating the increased volume of pregnant solution, the occasional waste of surplus barren solution, and the extra cost of heating buildings. With increased cost of cyanide and zinc over the figures quoted, the economy would be in favor of filters. The Hollinger is now installing Oliver filters to follow decantation, which would indicate that the cyanide and dissolved-value losses are sufficient to warrant this additional step.

During the first year or two of milling under Noel Cunningham's direction we experimented with solution strengths from ½ lb. to 2 lb. of cyanide per ton of solution, and found 1.1 lb. the most satisfactory. In 1916, when cyanide had risen to 33c. per lb., L. B. Eames, superintendent, experimented with solution strengths down to ½ lb. per ton, but our tailing showed an increase of 30c. per ton and we went back to 1 lb. solution strength.

In the original mill, concentration had been figured at about eight tons gross per day per table top, on the supposition that about five or six tons would actually pass over the tables. Gradually it was found that an allowance of one table to about thirty tons of ore stamped gave all of the concentration necessary, but never did any of us feel that concentration should be abolished.

Benjamin Arthur Hoskins

An Appreciation

By Arthur Thacher

BENJAMIN ARTHUR HOSKINS died at his home at Van Nuys, Cal., on June 9. He was born on March 16, 1849, at Dodgeville, Wis. His father, a Cornish miner, went to Dodgeville in 1846, with the influx of Cornish and Northumberland miners to open the lead mines of Wisconsin. His mother was an Arthur from Devon, and her mother was a daughter of Lord Warren, of Devonshire. Their old home, a stone house, is still standing near the tracks of the Illinois Central R.R.

It was a wild country, and the opportunities for an education were exceptionally limited. As a boy, "Uncle Ben" sorted galena from the waste dumps, which was received as cash at the stores. At about eleven years of age he joined his father in lead mining and received "boys'" wages. Later, he went to the Lake Superior copper mines and then to Utah and Nevada. At Bingham Canyon he introduced the hand jig for concentrating lead ores. Later, he was attracted to Arizona and reached Tucson in July, 1878. There were no railroads in Arizona at this time, and the Apache indians were pretty troublesome.

In the spring of 1879, I had the good fortune to meet "Uncle Ben" at Oro Blanco and since then I was associated with him until his death. In the early '90's he was running the "Reward" gold mine, in Inyo County, Cal. Later he came to Missouri and had charge of the mining work of the Central Lead Co. The property was sold to the Guggenheims in 1905, and on Jan. 1, 1907, he went to Mineral Point, Wis., for the Mineral Point Zinc Co. and continued in this field until operations were suspended in 1921.

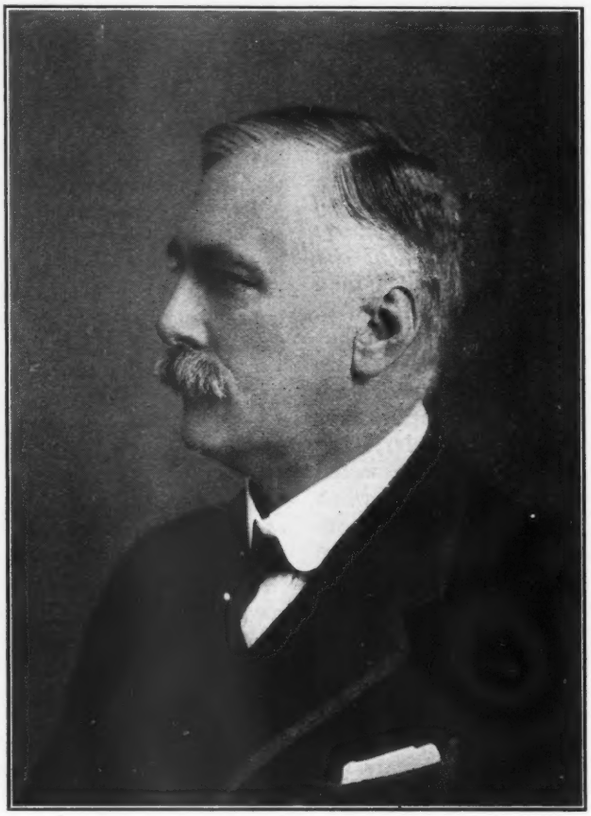
"Uncle Ben" had all the firm integrity of the Pilgrim fathers of New England, who were also from Devonshire. Together with this was coupled their passion for pioneer work, which caused him to roam through our Western mining camps. This was characteristic of the Wisconsin lead miners, for you found them in all the early Western mining camps. An expert miner, with rare judgment and vision, he left his impress in every place that he visited, and if he had had a broader early education his name would have stood out as one of our greatest mining engineers. Considering his opportunities, his achievements were to a high degree creditable.

It is, however, as a man that we wish to think of "Uncle Ben." He had the greatest love for humanity, and this, tempered with justice, was constantly spreading out to all with whom he came in contact. Standing for the highest ideals, the good that he did spreads out and will never die. It is the greatest monument that one can give to his fellow men.

Mining Engineers of Note

A. G. CHARLETON

BUT for an accident at football A. G. Charleton would have entered the British army. He is a Jersey man, born at St. Heliers, on Jan. 6, 1858, and is descended from a distinguished family of army men; his great-grandfather commanded a battery of artillery at Yorktown under Lord Cornwallis, and his grandfather was the sole survivor of two brothers blown up at Fort Erie together with a great-uncle on his mother's side. Fortunately for the mining profession, he followed the advice of the late Sir Andrew Ramsay and Thomas Etheridge and entered the Royal School of Mines, in 1876. At that period this institution possessed such noted professors as John Percy (metallurgy), Sir Warrington Smyth (mining), Judd (geology), Huxley (biology), Guthrie (physics), and Etheridge (paleontology). In 1880, Mr. Charleton decided to continue his studies at the celebrated Berg-Akademie, at Freiberg, in Saxony. At this time there were many noted American mining engineers studying there, among them John Hays Hammond and F. G. Corning, whose reminiscences of the old school, entitled "A Student's Reverie," have lately been published. Freiberg in those days was not only instructive but interesting. The Berg-Akademie also possessed many distinguished professors. Thus, Professor Richter taught metallurgy and blowpipe analysis; Professor von Cotta had but recently retired as professor of the study of ore deposits; Stelzner was professor in geology. Mr. Charleton was a hard-working and industrious student and he frequently burned the midnight oil, working at one time thirty-six hours at a stretch, to worry out the problem of "Pothenotesche Aufgabe"—all done, by the way, for the sake of procuring the use of some surveying instruments during the summer vacation. From Freiberg he went to Canada and afterward to Nevada, and the experience gained in those early days has proved of great service to him. Mr. Charleton's first appointment as assistant superintendent was on the recommendation of his old friend, R. P. Rothwell, who was consulting engineer to the celebrated Del Oro mine, at Marmora, in Canada, which produced an exceedingly refractory arsenical gold ore. In 1885, Mr. Charleton went to Queensland, where he was placed in charge of the Disraeli mine. He subsequently made some important and indeed prophetic reports on the Wynaad gold district, India, as he was obliged to condemn the "reefs" as too narrow and low grade to be payable. While in India he visited the Mysore gold fields, of which, on the other hand, he formed a favorable opinion that has since been confirmed. Later he reported on the concessions of the Pierrefitte company, in France, in the Pyrenees, containing several silver-lead and zinc properties. In 1895, Mr. Charleton began practice in London as a consulting engineer, visiting and reporting on mines situated in various parts of the world. He published at this time his "Report Book for Mining Engineers." In 1902, Mr. Charleton was elected president of the Institution of Mining & Metallurgy, of which he was one of the founders. He is a past member of the Advisory Board of the Royal School of Mines, was called to give evidence before the Departmental Committee on Technical Education at South Kensington, and also was a witness before the Board of Trade Commission, in 1904, for the revision of the latest Metalliferous Mines Act and Regulations. In 1907, Mr. Charleton's late firm, Charleton, Dickinson & Co., designed the equipment of the Robinson shaft. Since the war, Mr. Charleton has been occupied with the preparation of a series of technical publications for the Imperial Mineral Bureau and for the Imperial Institute.



A. G. CHARLETON

Mr. Charleton says he considers that the most important objects in life are good citizenship, good fellowship, good education, and personal ambition to succeed, *uncontaminated* by petty jealousy and selfishness. Couple with these a will to work and to put one's hand to any honest job that comes along, and then do it to the very best of one's ability. "Character," he says, "is of more value than wealth, and wisdom, born of experience, than power."

THE PETROLEUM INDUSTRY

Road over Tehachapi Pass between Los Angeles and Bakersfield

Oil Industry in California

By Dr. Henry M. Payne

SUCH WIDE DIVERGENCE of opinion regarding the probable life of the California oil fields has been expressed that a résumé of present conditions is pertinent. Probably none of the oil-producing states has given more attention to the preservation and correlation of its oil-well records than has California. The closest co-operation exists between the producing companies and the state officials. The State Oil and Gas Supervisor and his six deputies offer prompt service and information regarding anything which will assist in drilling and maintaining wells in accordance with approved methods; and the geology of all the operating districts is graphically exhibited by "peg models" in each branch office of the bureau.

The peg models were first used by the Kern County Oil Protective Association, and were exhibited at the San Francisco Exposition in 1915, before the organization of the State Oil and Gas Department in California. The present models consist of pegs, set in boards, upon which a map of the area has been drawn to a scale of 100 ft. to 1 in. Each peg is inserted on the site of a well, and the board represents an assumed datum plane sufficiently low to include all development in the district. The Kern River field base is shown as 3,000 ft. below sea level. Blueprints, to scale, showing the log of the well, graphically, are pasted to the pegs. The vertical and horizontal scales used are equal, thus avoiding distortion of dips or structural conditions. Colored map tacks are inserted to indicate various formations, and strings of similar color are then stretched from the corresponding tacks in all pegs, thus making it possible to visualize the stratigraphy of the whole area.

The "chromography" in standard use is red for oil, yellow for water, brown for marker, white for point of shut-off, blue for bottom of well, and black for gas. The pegs used are of pine, ½-in. in diameter; they range in length from 30 to 48 in. No attempt is made to cut off the pegs to show surface levels, as it is more advantageous to have them all of the same length, and braced across the top. After a few wells have been drilled in any area, the peg model assumes rapidly increasing importance, and the saving of one string of casing or the discovery of additional oil sands on a lease more than offsets the expense of building the model.

Excellent state roads have been built to all the oil fields, and frequent bus service is provided from Bakersfield and other centers. The road over Tehachapi Pass, the "Grapevine," shown in the accompanying half-tone, and similar construction have placed all the active districts in close touch with Los Angeles. New work development. Two wells are being drilled; both report gas, but are not deep enough to "prove up."

The process of cleaning up old wells consists of pumping hot oil at a temperature of 160 deg. F. under a pressure of 700 lb. to clean out the perforations and break up the bridging of the sands. This hot oil melts

Headquarters of the Pacific Oil Co.

is curtailed since the strike, due largely to a surplus of oil; the storage capacity is limited, and all the tanks are full.

The clearing of titles in parts of the Buena Vista Hills field, and the granting of leases on certain sections which were in litigation in the Naval Reserve, have served to open a few new districts. Notable among the new operations are those of the Pan-American company, in the Elk Hills region; the Tupman lease; and a new camp of the Pacific Oil Co. It is understood that the new operators on the Naval Reserves are paying the Government a royalty in oil in return for the leases.

Public Utilities Provided

The town of Ford, for which application for a town site was rejected by the Government, is nevertheless going ahead with construction on leasehold property. Gas is supplied by the Midway Gas Co., electricity by the San Joaquin Light & Power Co., and water by the Western Water Co., to the towns of Taft, Maricopa, and the surrounding camps. The Pacific Oil Co., formerly the Kern Trade & Oil Co., closely allied to the Southern Pacific interests, is moving its Kerto camp from near Maricopa to a point about three-quarters of a mile northwest of Taft, and is building a new permanent camp for its main offices in the West Side field.

In the Midway field most of the drilling being done is to meet lease requirements as to new and offset wells, The greatest interest at present is in the Fern Front, an area about four miles northwest of the main Kern field. The Standard and Union Oil companies are bringing in a few new wells nine miles northwest of Bakersfield. Some of the old wells are being cleaned up and pumped, but most of the wells, except "line" wells, are closed down.. The Comanche Point district, twenty-five miles southeast of Bakersfield, is a new

down the asphaltic material, on which water has no effect. The oil cools from 30 to 40 deg. in reaching the point of attack. In some instances a pressure of 250 to 400 lb. will do the work.

Kern River Field Has 2,000 Producing Wells

The average depth of the Kern River field is 1,000 ft., and there are about 2,000 producing wells. This field has been producing for twenty-two years, and on account of the thick sands it is predicted by many that it will be good for twenty or thirty years more. The decrease in production has been small. The average production per well per day in the entire field is 10 bbl. In Sec. 5, along the center of the field, the hot-oil cleaning process has induced triple production, which seems to be holding up. The Santa Fé flat field southwest of Kern River is at present held in reserve. Near Bakersfield oranges and oil are found in surface and sub-surface combination.

The Midway field, on the west side of Kern River, comprises principally the Midway, Sunset, McKittrick, Belridge, Lost Hills, and Elk Hills districts, and a part of the Devil's Den, with a total of about 3,500 producing wells. The average depths and productions are as follows:

District	Average Depth, Feet	Average Production Bbl. per Day Per Well
Midway	2,200	35
Sunset	2,800	35
McKittrick	2,000	25
Belridge (six years old)	1,200	9
Lost Hills (ten years old)	2,000	9
Elk Hills		
East end	3,000	When new, 900
West end	3,600	Now 400
Devil's Den	150–500–1,600	(a)

(a) The Devil's Den section is a varying shallow pool in which seepage from adjoining fields collects. No figures on production are available.

Considerable wildcatting is being done by the National Exploration Co., the Petroleum Midway Co., and

the Dutch Shell interests. The Elk Hills and Buena Vista fields are extensions of the anticlinals of the earlier operations. Nothing especially new has been found so far.

McKittrick is the only place in the West Side field where the hot-oil treatment is used, as the Midway and Elk Hills oil is 20 deg. Bé. and higher, and Buena Vista, 23 deg. The gravity of the oil is apparently determined by the grain of the sand, the fine-grained beds carrying the lighter oils, although it is logical to expect light oil at the highest point in the anticline. The addition of sulphur from contact with surface water also tends to the deposition of tar; hence the position of the oil sands with relation to mineralized water has much to do with the life of a well.

Rotary drilling is practiced in fields already proved, where, by reference to peg models, the distance to the oil sands may be forecast accurately. For wildcatting, however, the rotary drill is considered inefficient and unsuitable, as, instead of using casing, the hole is mud-cemented, thereby preventing the operators from obtaining any knowledge of the core.

The fact that existing storage space is kept full and that production thereby has been limited has had much to do with uniformity of price on California oil. There have been only two 25c. reductions in price, on the basis of 16 deg. Bé. oil, since the peak during the World War.

Pipe Lines to San Francisco Bay

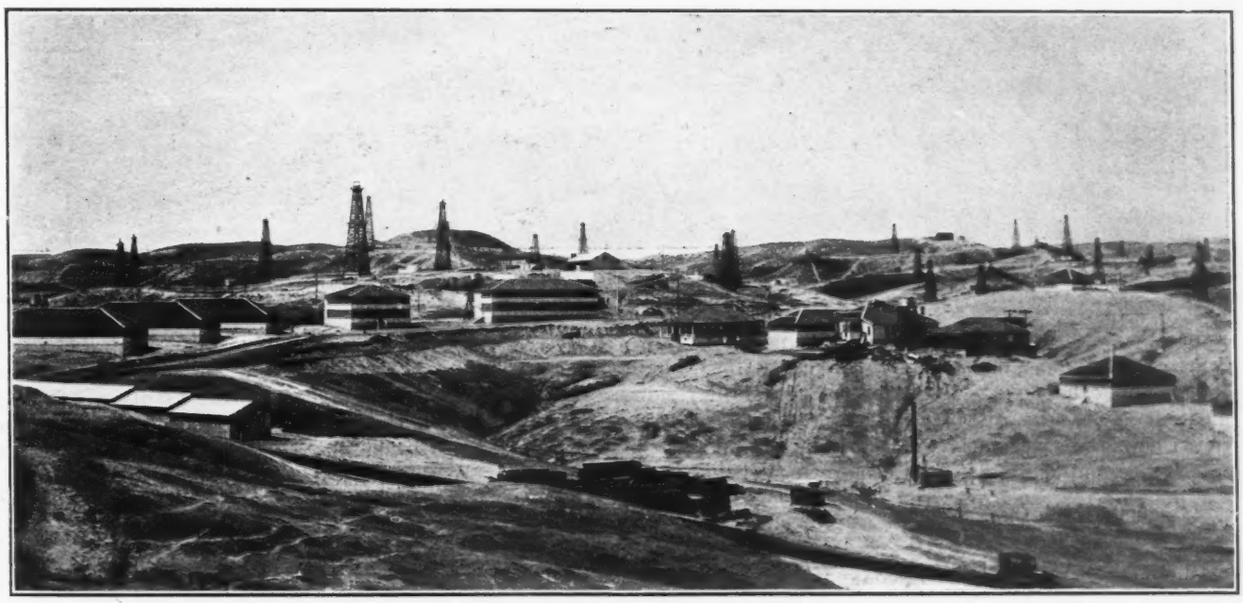
The oil from the fields controlled by the Standard Oil Co. is piped to San Pablo, in San Francisco Bay. That from the Associated Pipe Line Co. (handling the Southern Pacific and the Pacific Oil output) goes to San Francisco Harbor, as does also the product of the Dutch Shell Co. The Producers' Transportation Co., as its name implies, is a transportation company only, and is controlled by the Union Oil Co.; it delivers the product of the latter to San Luis Obispo. The Honolulu Oil Co., the Sante Fé Oil Co., and others deliver through the lines of the General Petroleum Co., which run from the Midway district to San Pedro.

The gravity of the oil delivered at San Pedro varies from 12 deg. to 30 deg. Bé. and averages 17 deg. It is therefore necessary to operate pumping stations every fifteen miles. These pumps operate at 600-lb. pressure, with steam at 150 lb., and throw one barrel of oil per stroke. The oil, on account of its viscosity and low gravity, is heated to 140 deg. F. by exhaust steam, to facilitate pumping. The steam is afterward condensed. In the winter the temperature of the oil drops from 140 deg. F. to 80 deg. F. in transit from station to station, where it is reheated and pumped on. The temperature in summer drops from 140 deg. F. to 100 deg. F. in transit. Crossing the Tejon Pass, the pipe line gains 1,000 ft. in elevation every five miles, so that to maintain the standard 600 lb. pipe-line pressure, pumping and reheating stations are installed every five miles.

The 200-mile main line to San Pedro is 8 in. in diameter. Feeding this are 100 miles of 4-in. and 6-in. branch line. At San Pedro the oil is discharged into a concrete reservoir of 500,000-bbl. capacity, and into six tanks of 55,000-bbl. capacity each, making a total continuous reserve of 830,000 bbl. at this port. The last pumping station on the line is at San Pedro and is used for loading the boats. In addition to the 830,000-bbl. capacity of the San Pedro storage, the General Petroleum Co.'s line from Lost Hills to Vernon Refinery, at Los Angeles, has 50,000 bbl. in continuous transit.

Much trouble has been experienced from the action of alkali on the pipe lines, necessitating their frequent renewal. The Standard Oil Co. tried laying these lines in concrete, but the alkali penetrated this. A preparation called Oronite has now been developed by the Standard Oil Co., which is being used by the pipe-line companies to clean and treat the pipe, after which the line is coated with Petrolastic, another Standard Oil product, developed for this purpose. This method has proved more successful than any other, and has lengthened the life before re-treatment to five years.

Of the total production of the California fields, 1 per cent goes to the railroads for fuel and 99 per cent



Buildings on the Tupman Lease

to the pipe lines. The companies producing light oil and needing heavy oil for fuel, or possessing no refineries themselves, often exchange with other companies that are producing heavy crude oil or a residuum from refining.

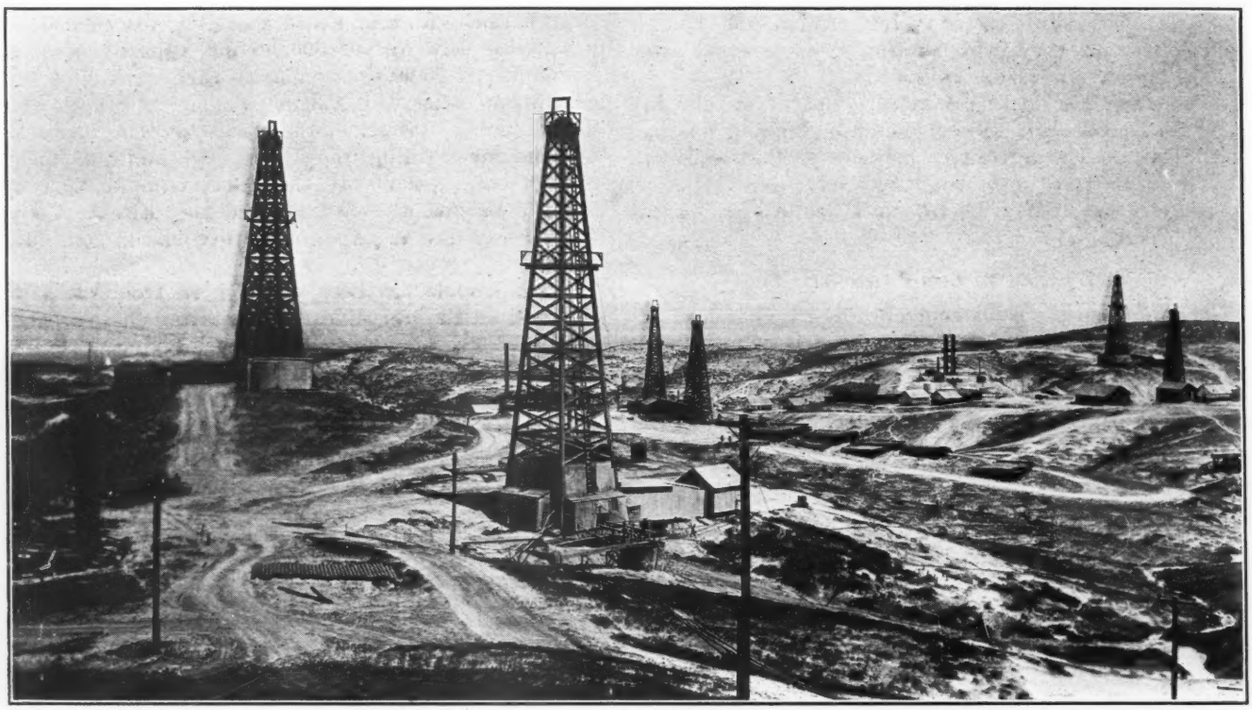
Standardization in the field has reached its highest development in the operations of the General Petroleum Co. Complete standards have been established in drilling, for tools, equipment, and speeds; in pipe-line construction and maintenance; for pipe fittings, field pumps, tool boards, and supplies; in camp construction; and in pumping stations. Each pumping station is provided with a tool board of uniform size and equipped with tools in such diversity and size as experience has indicated advisable. These tool boards are painted dark gray, with the exact outline of each tool painted in white. A glance at the board from across the room indicates instantly just which tools are in use or missing. In the supply houses, spare valves, fittings, chain tongs, and other parts and supplies are similarly indicated. These boards being exactly alike at all stations, employees become trained and habituated in the proper use and replacement of tools. A saving of time and of tools for replacement is thereby effected.

Standard Methods Are Employed

Uniform methods are also in vogue in the maintenance of power equipment. The outside installations are first painted with Sipes' oil (a low-grade raw linseed), and flake graphite is then rubbed in. This gives an attractive silver coating, impervious to the weather, which lasts for three years without further treatment than daily wiping. The inside power-house equipment is painted first with battleship-gray concrete enamel thinned down; and when partly dry, flake graphite is applied and the whole surface is polished like a pair of shoes.

Water is taken from the hot-well at 170 deg. F. and passed through a Cochrane heater and into the boilers at 210 deg. F. The General Petroleum Co. has a 4-in. water line from Belridge to Semi Tropic, a distance of twenty-five miles, which was welded by the oxyacetylene process. From Midway to the Tejon Pass the same company has a 15-in. gas line, fifty miles long, which was similarly welded. Neither of these lines has ever developed a leak, and the cost was less than that of a coupling and screw line. It appears to be the consensus of opinion that welded lines will ultimately be standard, as they eliminate patrols, "collar" leaks, and repairs. As portable electric-welding outfits develop, they will compete with the more unwieldy oxyacetylene equipment.

Until about 1919, it was customary for a pipe-line rider to "blow off" from 30 to 50 gal. of gasoline at the "drips," situated approximately twenty miles apart, every morning. As the demand for gasoline increased and threatened a shortage, absorber plants were developed to take out the gasoline. These plants consist of a vertical steel tank, into the bottom of which gas is introduced. Oil lean in gasoline is passed in at the top and down over baffles, the gas meanwhile passing up through the oil. The oil emerges at the bottom, saturated with gasoline, while the unabsorbed gas passes off dry at the top. The gasoline is then volatilized out of the oil in steam stills, and the oil is re-used. After this process had been installed, however, pipe-line leaks occurred with increasing frequency. Dry gas was observed seeping up through the ground from each joint. It then became necessary to take up and re-gasket the entire pipe line. To obviate this expense, it has become customary to pump kerosene or other light distillate through the lines for one day, at intervals, thereby keeping the gaskets sufficiently moist to prevent dry gas leaks.



New rigs of the Pan-American Co. in the Elk Hills field

In the Los Angeles field there are nine producing districts, data concerning which are compiled below:

	Field	Remarks	Average Number of Wells	Average Depth Feet	Average Production per Day, in Bbl.
	Signal Hill or Long Beach	New field due south of Los Angeles, dips east	75	2,500-3,600	304
(a)	Huntington Beach	East of Long Beach	180	3,600-4,200 (Center 2,500-2,800)	315
	Richfield	Southeast of Los Angeles	115	3,300-3,500	245
(b)	Santa Fe Springs	New district	4 producing 46 drilling	3,800-4,000-4,500	1,743
	Montebello	Older field	170	(Center 2,500-3,000) (South 3,000-3,500)	176
(c)	Whittier	Older field	170	2,500-3,000	21
(d)	Brea-Olinda	Older field	500	Brea 4,000 Olinda 3,000-3,500	45
(e)	Coyote Hills	Older field	East 105 West 85	3,000-3,300 3,500-4,500	92
(f)	Salt Lake	Due west of Los Angeles	180	1,500-3,000	11

(a) None of these wells appears to have gone through an intermediate water belt.
(b) The first was a 4,000-bbl. well of 32 deg. oil. A gas zone which occurred below 2,000 ft. and above the top of the oil at 3,800 ft. has become a source of commercial gas supply.
(c) Three distinct zones of production, with steep planes.
(d) The original well developed on the Brea-Olinda was in the Monterey series, north of a big east-west fault. Later developments started in the Fernando or Puente, the Puente being a transition between the Monterey and the Fernando. No water is found below 200 ft. in the Brea-Olinda field. Heavy oil occurs under low pressure and in small quantities above the brown shale parting which segregates the Fernando and the Puente.
(e) There is evidently a trough in the anticline, as the center appears barren.
(f) This is a larger area than Huntington Beach, and the wells are wider spaced.

Of these districts the Long Beach, Huntington Beach, and Santa Fé Springs are of special interest; likewise a new zone recently discovered in the Montebello field. All give promise of a large production. A new field, the Redondo, is being drilled, but no production has yet been made. A well being drilled by the Santa Fé has shown oil between the casings.

It is probable that in the Long Beach and Santa Fé Springs regions commercial gas will be developed, which will include the recovery of gasoline when possible. In some of these wells, the gas is dry and under high pressure; consequently, no gasoline is obtainable. The closer the proximity of the gas belt to the oil sands, the greater the probability of obtaining gasoline. Many of the old fields will be rejuvenated by improved methods of extraction. Some geologists estimate that up to the present time not exceeding 20 per cent of the available oil has been extracted.

The Western Union Co., in the Santa Maria field, began to take the temperature of the oil in the well, and so designed a pump plunger, based on the coefficient of expansion, to give a higher efficiency in pumping. Up to the time that company began to record temperatures, its maximum extraction had been 5 bbl. per well. With the newly designed pump this became 10 bbl.

One of the difficulties with certain oils, as in the Montebello field, is that an amorphous wax (not paraffine) deposits inside the pipe lines, and it is necessary to send a "go-devil" through the line at frequent intervals—always as often as once a month. This does not occur in the other fields. When distillate is available a passage of it through the line dissolves a portion of this wax, and postpones the "go-devil" cleaning.

In co-operation with the State Oil and Gas Department, Dr. E. Call Brown, geologist of the California Petroleum Corporation, is making a systematic study of shales by microscopic examination, and correlating the various strata. In the California oil fields the oil zone consists of sands or a series of sands lying between water strata without reference to lithology. The use of rotary drill for wildcatting is disadvantageous, and Dr. Brown is having cores taken at intervals of 50 ft. by substituting special core bits for the rotary fish-tail type. When approaching the oil sands, cores are taken every 10 ft., and then every 5 ft. The time required for the substitution of bits and taking a core is about five hours, but the method, first tried in September, 1921, has given excellent results.

The end of the core bit is usually fused and has to be cut off with oxyacetylene. This is one of the problems to be overcome. When the core barrel gets too hot, the sands are fused; or, when not fused, the oil is distilled, and consequently is not found in the core. The study of this method includes determination of the pressure to be applied, the heat conductivity of the material, and the speed of rotation. It has been found that 300 r.p.m. is too fast. A new type of disk-cutting drill is now being designed which will cut at the maximum rate under a slow speed, and deliver the core at a lower temperature, thus enabling the transverse cutting of the core and the microscopic determination of the formation passed through.

The oil industry in California is devoid of the usual excitement attendant upon the development of new fields, but work is proceeding in a scientific manner to conserve and intelligently utilize this great source of wealth and power. Abandoned wells supposed to be exhausted are carefully protected against infiltration of water, at the insistence of the state officials. Impervious plugs are inserted against the day when improved methods shall have made it practical to reopen these wells and extract additional oil.

Cash Prizes for Photographs Showing Relative Durability of Copper

As a part of a nation-wide campaign designed to foster the use of more permanent materials in building, the Copper & Brass Research Association has announced cash prizes for the best photographs showing the relative durability of materials which go into the construction of American homes.

Some idea of the cost to this country of the practice of building for speculative profit rather than for use is evidenced by the result of a statistical study just completed by the Copper & Brass association. The fire loss on the 21,000,000 American homes, insured as they are for a total of $91,700,000,000, is about $35,000,000 a year, based on figures for 1918 to 1920, inclusive. The annual rust bill, covering the renewal of sheet-metal work, principally leaders and gutters, plumbing pipe, and hardware, is twenty times that sum.

The effort to show the public the wastefulness of the use of materials which need early and frequent replacement is a part of the present intensive campaign of the copper and brass companies of the country to increase the use of those metals in domestic consumption. The photographic contest is a part of that campaign.

Fourteen prizes ranging from $150 to $10 will be awarded for photographs of copper and brass objects of utility or ornamentation, which, to qualify, must have been in use more than thirty-five years. Included are copper roofs, brass door knockers, old copper cooking utensils, and brass plumbing pipe. Fourteen additional prizes of similar amounts are offered for the best photographs showing the results of using substitutes for copper and brass.

SOCIETIES, ADDRESSES, AND REPORTS

Metallurgical Progress in the Butte District*

Butte owes its start in life as a silver camp to the fact that copper sulphide oxidizes to a sulphate which is soluble in water. The redeposition of the leached copper gave rise to the formation of the huge masses of extremely rich copper ore at comparatively shallow depth, which made the development of Butte as a copper camp a possibility at a time when ore such as is being mined today would have been worthless, and thus hastened the development of the district, and indeed the State of Montana, by many years.

The copper ores which came from the mines in those days were sent, for treatment, to Swansea in Wales, which at that time was one of the great metallurgical centers of the world.

This period, however, was of brief duration and it was not long before works were established here for the treatment of these as well as leaner ores. Many of you probably retain vivid recollections of the days of the roast heaps on the flat below the city, when the air was made almost unbreatheable by sulphur fumes and the fog in the streets was so dense as almost to hide from the view the buildings on the other side.

It is a far cry from the metallurgy of those days to the metallurgy of today, and while some of the processes in present use depend upon the same fundamental principles, others, on the contrary, make use of totally different chemical or physical phenomena.

A most striking example of this is furnished by concentration. The object of concentration is to separate the copper-bearing minerals or sulphides from the worthless rock with which they are mixed in the ore which comes from the mines. The ores which were taken from the enriched zones in the bonanza days were almost pure sulphides and contained only a trifling admixture of earthy impurities and could be smelted directly. The earthy impurities, which were present in the later lower grade ores, had to be removed before the sulphide could be smelted. This was done by taking advantage of the fact that the sulphides are comparatively heavier than the gangue, so that by washing the finely crushed ore with water in suitably constructed machines known as jigs and tables the lighter gangue was washed away, leaving the heavier sulphides containing the copper minerals behind.

While this method served its purpose fairly well, particularly as long as the ores were rich in copper sulphide minerals, its defects became more and more apparent as the ores became lower grade and the minerals and gangue became more and more intimately associated, thus making necessary finer and always finer grinding to free the mineral grains from the adhering rock or gangue particles.

Thus the so-called "slime problem," for long the "*bête noir*" of the mill man, became increasingly troublesome, and although many ingenious machines were thought out and constructed to recover the valuable minerals from the slimes, none of them really solved the problem in a satisfactory manner.

Then quite suddenly came the flotation process and solved the difficulty by making use of an entirely new principle; viz., that of surface tension. By the use of a minute quantity of oil violently churned into a mixture of finely ground ore and water, in such a manner as to entrain air in the pulp, a froth, in appearance much like soapsuds, was produced, and to the bubbles constituting this froth the sulphide mineral particles were found to be attached. The froth, although loaded with mineral, floated on the surface of the pulp and could be skimmed off.

Thus the old concentration process has been reversed, and where in the old-time jig the tailings overflow and the copper concentrate is drawn off beneath, in the modern flotation machine the copper concentrate overflows and the tailings are drawn off beneath.

The smelting of the concentrates from the flotation machines afforded another problem which taxed the ingenuity of the metallurgical engineer. These concentrates are of extreme fineness, and when they are passed through the roasting furnaces, in which a portion of the sulphur contained in them is burned out, and through the reverberatory smelting furnaces, in which they are smelted to slag and matte, much dust is made which blows out of the furnaces. Flue dust is nothing new to the smelter man, and the old furnace men caught it in huge chambers in which the velocity of the dust-laden gas from the furnaces was reduced to such a point that the dust particles were enabled to settle out like the silt out of muddy water in a still pond.

The dust from flotation concentrates, however, was of such excessive fineness as to render futile such comparatively simple and straightforward methods. At the smelting works in Anaconda there are a mile of flues and dust chambers which are utterly unable to catch the excessively fine dust coming from the furnaces receiving flotation concentrates.

Confronted with this dilemma, a new principle had again to be pressed into service, viz., the application of static electricity to the settlement of dust particles—I refer to the Cottrell process.

The dust caught by this process is not only rich in copper, silver and gold, but also contains such comparatively volatile metals as bismuth and arsenic, which the old-time settling processes were quite incapable of catching. These bid fair to prove quite valuable and arsenic is already being recovered from this dust with considerable success. The recovery of bismuth is still in the dream phase, and although theoretically possible, cannot as yet be economically carried through.

I might trace for you the growth of our blast furnaces from the early pigmy stages, when they were called cupolas and were hardly more than four feet in diameter and were charged by hand, to the last furnace to be build in Anaconda, which had a length of 87 ft. and smelted daily almost 3,000 tons of ore and flux.

This was the largest blast furnace ever built and probably the last of its kind since the changes in our methods of ore concentration have almost made the blast furnace obsolete and have brought about the pre-eminence of its old rival, the reverberatory furnace.

Many of you have probably heard reference made to so-called complex ores. Whenever the prospector encountered ore of this character, he generally quit in disgust because he knew that although such an ore might contain good values in the aggregate they were divided among so many different metals that no smelter could recover all of them, and generally the value of the recoverable metals was not sufficient to pay the cost of mining and treating. Such ores always contain much zinc, and this metal, so far from having value, was a source of expense because it made trouble in the furnaces and was therefore penalized by the smelters. The ore when concentrated yielded a concentrate containing only about 30 per cent of zinc, and this was too low grade to permit of its being shipped to the zinc smelter, which required a concentrate assaying about 50 per cent zinc.

The problem was therefore to devise a process for extracting zinc profitably from the concentrates resulting from these ores and thus, by changing the status of zinc from a penalized metal to a revenue producing metal, make the ore sufficiently valuable as a whole to make the mining of it profitable.

*Abstract of address delivered to the graduates of the Montana School of Mines, by Frederick Laist, general manager, Washoe smelter of Anaconda Copper Mining Co.

Eighth Annual Meeting of A.A.E. at Salt Lake City

The American Association of Engineers held its eighth annual convention in Salt Lake City, Utah, June 5, 6, and 7. Headquarters were at the Hotel Utah, and those in charge were J. C. Ullrich, N. G. Harmon, president of the Salt Lake chapter, and C. E. Painter. Special automobile service was arranged for the visiting engineers during their stay, and they were shown points of interest in the city and vicinity. Business meetings were held, and technical subjects discussed. Some minor changes were made in the constitution of the association. A resolution was adopted favoring the passage of the Smith-McNary reclamation bill, now before Congress, and telegrams to that effect were sent to Washington. Officers were elected for the coming year as follows: A. N. Johnson, dean of the College of Engineering of the University of Maryland, president; G. E. Taylor, vice-president; and A. M. Knowles, second vice-president.

Far Eastern Bureau of Mines Established

The Far Eastern Bureau of Mines has been established at Harbin, Manchuria, China, for the purpose of promoting the mining industries in Manchuria and Far Eastern Asiatic Russia, giving information concerning mining enterprises in that part of the world, and endeavoring to attract foreign capital. Many former Russian capitalists are now living at Harbin and have properties in Siberia, in which they are anxious to interest foreign investment. P. I. Zaitzeff is managing director and F. J. Hlebnikoff is assistant mining engineer in the bureau.

MEN YOU SHOULD KNOW ABOUT

D. F. Hewett has returned to Washington after a Western field trip.

Durand A. Hall has returned to San Francisco from La Paz, Lower California.

R. H. Stewart has returned to Vancouver from an examination of mines in Texas.

G. H. Girty and **P. V. Roundy** are in southern Oklahoma on geological investigation.

C. C. Broadwater, of the Merrill Co., has returned to San Francisco from New York.

R. L. Chase, of Denver, has gone to the White Hills district of Arizona on geological work.

C. E. Knox, president of the Montana Tonopah Mines Co., has returned to Berkeley from Tonopah.

Dr. R. C. Wallace, of Winnipeg, is examining a number of properties in the Elbow Lake mineral belt.

Dr. Pentti Eskola, of Finland, will collaborate in the work of the Canadian Geological Survey this season.

Hjalmar E. Skougor, consulting industrial engineer, has moved his office from 150 Nassau St. to 287 Broadway, New York City.

Charles F. Rand was elected president, and **C. Minot Weld** vice-president of Moa Bay Iron Co., at the annual meeting June 7.

D. Dale Condit has returned from India, where he has been engaged in geological work. He will go back to India in August.

J. H. Curle, who returned recently from a journey to Morocco, the Congo, and Southwest Africa, is now on his way to Hudson Bay.

G. M. Butler, of the Arizona School of Mines, has received the honorary degree of Doctor of Sciences from the Colorado School of Mines, at Golden.

Herman Dauth, who has been chief engineer for the Tonopah Belmont Development Co. for several years, has resigned and has moved to Los Angeles.

Dr. F. J. Alcock, of the Canadian Geological Survey, has gone to spend the summer investigating the formations of the Elbow Lake mineral area in northern Manitoba.

Hugh F. Marriott, for many years consulting engineer to the Central Mining & Investment Corporation, has, according to the annual report just issued, resigned his position.

Olaf P. Jenkins is taking charge of geological investigations of the coal in Whatcom and Skagit counties, Washington, for the State Division of Geology, Department of Conservation and Development.

Byron Wilson, formerly of the engineering staff of the Federal Mining & Smelting Co. at Wardner, Idaho, has gone to Willow Creek, Alaska, where he will take over the management of the Rae-Wallace property.

E. L. Gruver is now associated with the newly formed firm of Ward, Gruver & Co., which will take over and continue the stock, bond, and investment business of Keen & Ward. Their offices are at 20 Broad St., New York City.

W. J. Olcott, president of the Oliver Iron Mining Co.; **J. H. McLean**, general manager, and **John Uno Sebenius**, general mining engineer, are making a tour of inspection of the properties of their company on the Mesabi iron range.

James S. Colbath will sail from San Francisco on July 6 for the Philippine Islands, where he will be temporarily engaged by the Benguet Consolidated Mining Co., Baguio, Benguet, as metallurgist in charge of the design and construction of a new plant.

Walter E. Gaby, until recently geologist for the Mexican Corporation, Ltd., directing exploration of a copper-zinc deposit at Teziutlan, Puebla, is returning to Salt Lake City, his home, where he may engage in consulting practice as an engineer and mining geologist.

Dr. R. B. Moore, chief chemist of the U. S. Bureau of Mines, delivered a lecture at the University College of London on May 24. Dr. Moore was introduced by Ambassador Harvey. Dr. Moore's topic was "Commercial Manufacture of Helium by the Government of the United States."

Mining and metallurgical engineers visiting New York City last week included: **U. A. Eilertsen**, of Hancock, Mich.; **William Gretzinger**, of Pittsburgh, Pa.; **Albert S. Walker**, of Buffalo, N. Y.; **T. R. Leighton**, of Cuba; and **J. C. Roberts**, of Golden, Col.

SOCIETY MEETINGS ANNOUNCED

The **Lake Superior Mining Institute** will hold a meeting at Houghton, Mich., during the week Aug. 20-26. Features of the program will be visits to the Calumet & Hecla leaching and reclamation plant at Lake Linden and to the new hoist at No. 2 shaft, Quincy mine.

The American Institute of Mining and Metallurgical Engineers will hold a meeting in San Francisco Sept. 25 to 29. The technical sessions will be held at the Engineers' Club, and social headquarters will be maintained at the Palace Hotel. **F. W. Bradley** has invited the members to a reception and buffet supper at his home on the first day. An excursion to the Hetch Hetchy municipal water supply is offered to a party of not more than fifty men, under the guidance of **M. M. O'Shaughnessy**, the City Engineer. Alternative trips are offered to the Selby smelter, the University of California, Stanford University, Mount Tamalpais, Chinatown, and the golf courses of the bay region. Mr. Bradley is chairman of the Committee on Arrangements. Associated with him are **Fletcher Hamilton, Charles W. Merrill, Frank H. Probert**, and **T. A. Rickard**. The members resident in San Francisco are looking forward with keen pleasure to the opportunity of renewing acquaintance with their friends from other parts of the Union, and promise to do their best to make the meeting interesting and enjoyable.

OBITUARY

W. P. Hassell, who for many years was connected with the Joshua Hendy Iron Works, died suddenly in San Francisco on June 4. He was assistant to the president of the company.

Joseph Durkee died at Reno, Nev., on June 7 aged fifty years. Mr. Durkee was geologist and mining expert in the Land Department of the Southern Pacific Co.

W. E. Harrison, seventy-three years old, formerly metal mines inspector for the State of Utah, died on June 10, at Los Angeles, Cal.

New Books

Far Eastern Iron Deposits

Geology of the An-Shan Iron Mine District, South Manchuria. By Hanzo Murakami. Published by the Southern Manchuria Railway Co.

This excellently written little monograph describes an iron district not far back of Port Arthur, which was worked in a primitive way by the Chinese emperors a thousand years ago, but was unknown to the Russians; and was rediscovered in 1909 through a geological survey conducted by the Southern Manchuria Railway Co. Two blast furnaces were completed in 1919, with a capacity of 250 tons each.

The district is sixty kilometers wide, and abounds in iron, although not of high grade. The ores occur in pre-Cambrian hematite-quartz schist, and are unconformably overlain by Cambrian beds. The iron-bearing rock is an intimate mixture of hematite and crystalline quartz, generally containing less than 40 per cent of iron. A limited amount of ore has been concentrated or enriched by natural processes, so as to run over 60 per cent iron. On account of the limited amount of this better-grade ore, experiments are being made in enriching the primary ores by concentrating tables and magnetic concentration. The ore formation is of enormous thickness, and is uniform.

The iron ore of the An-Shan district is held to have many points of similarity to that of the Lake Superior region, in which the lean ores are likewise mixtures of hematite and silica; there is also a suggested similarity between the An-Shan iron-bearing schist and the iron-bearing schist called "itabirite" in Brazil.

The author conjectures as to the origin of the ores that they were precipitated from solution "chemically or by the action of some organisms in the shallow waters, such as swamps or lagoons"—in other words, that they are bog-ores.

The reviewer regards the suggested origin as unlikely, for various reasons. He believes that the iron ores of the Lake Superior region were deposited in marine relatively shallow-water sediments, as iron silicate, through the action of organic matter; and this original iron silicate he was the first to discover, on the Mesabi Range. This iron silicate breaks up into iron oxide or carbonate, and silica, and thus we get the characteristic iron-and-silica banded iron bearing rocks. The iron-bearing rocks of An-Shan, judging from descriptions and plates, are similar, and may well have had a similar origin, though the higher degree of crystallinity indicates conditions more favoring metamorphism than on some of the Lake Superior ranges. According to this view, these iron ores are all ancient greensand deposits. A proponent of the bog-ore theory must point out the stages of alteration to the present type of iron-bearing rocks, from known bog-ores; and a theory of an original marine deposition as iron carbonate must show such sediments now being laid down somewhere. Those geologists who are now studying especially the problems of sedimentation, can, if they will, do much to finally establish whether it is not true that some of the sediments which have been theoretically deduced as the original form of the precipitation of iron, in the Lake Superior district, for example, do not, as a matter of fact, occur in nature. J. E. S.

The Best Practice in Oil Firing

Burning Liquid Fuel. By William Newton Best. The U. P. C. Book Co., New York. $5.

This is a revised and enlarged edition of a work first published in 1913. The author dwells on the necessity of thoroughly atomizing the oil and use of a burner that will not carbonize. It is also more necessary than is commonly thought to have a burner that will make a flame to fit the combustion chamber "as perfectly as a drawer fits an opening in a desk." The book is well illustrated with photographs and diagrams, and contains chapters on the following subjects: Liquid Fuel, its origin, production, and analysis; Atomization; Oil Systems; Refractory Material; Locomotive Equipment; Stationary and Marine Boilers; and Low-Pressure Boilers and Hot-Air Furnaces; with separate chapters on the equipment used in the following industries: Commercial Gas, Sugar, Steel Foundry, Heat-Treating Furnace, Foundry, Forge-Shop, Boiler, Copper, Enameling, Chemical, Ceramic, Lime, Cement, Driers and Ore Roasters, Bread and Cracker, Chocolate, Oil and Tar Still, Incinerator, and Glass. The examples given of the use of oil burners in each of these fields are necessarily limited, for, in the 341 pages, the amount of text matter is restricted by the lavish use of cuts.

Information on Mexico for Americans

Mexican Year Book, 1920-1921. By Robert Glass Cleland. Mexican Year Book Publishing Co., Los Angeles, Cal. $7.50.

This is not a government publication and does not partake of the nature of undesirable propaganda. It is issued to meet the demand by the American public for unbiased and systematized information concerning our Southern neighbor. Each section is written by someone well qualified to discuss the subject which he covers: "History and Geography;" "Politics and Government;" "Travel and Transportation;" "Commerce and Manufacturing;" "Natural Resources;" "Public Finances, Currency and Banking;" and "Labor Conditions and Educational Systems." Three maps are included, one a large-scale reference map of the entire country, one showing the mining centers, and one showing the Panuco-Tuxpam oil fields.

Recent Patents

Metallurgy of Tungsten—No. 1,410,584. S. J. Lubowsky, Jersey City, N. J., assignor to Metal & Thermit Corporation, Chrome, N. J. Tungsten ore is roasted with a haloid salt of an alkali metal, the roast digested with a mineral acid, and the solid residue separated.

Concentrate Drier—Canadian patent No. 217,139. J. Norberg, Seward, Alaska. The patent covers an ore-concentrate drier comprising an inclined drier pan, with means for jogging it longitudinally, and a heater beneath.

Sulphur Dioxide—No. 1,417,066. G. C. Howard, Tacoma, Wash., assignor to American Smelting & Refining Co. A method of enriching a gas low in sulphur-dioxide content by vaporizing the gas from a water solution, and passing the vaporized sulphur dioxide into the low-grade gas stream. Patent No. 1,417,067 covers the process of passing a solution of sulphur dioxide counter-current to a mixture of sulphur-dioxide gas and water vapor, and then removing the sulphur dioxide from the solution. Patent No. 1,417,068 covers the manufacture of sulphur from liquid sulphur dioxide by vaporizing the liquid; mixing cold air with the vaporized gas; and reducing the mixture.

Manganiferous Gold Ores—No. 1,417,153. M. F. Fairlie and J. J. Denny, Cobalt, Ont. Manganiferous gold ores are treated with metallic iron and sulphuric acid, followed by cyanidation.

Electric Concentrator—No. 1,417,189. J. B. McCarthy, Copper Cliff, Ont. A rotating magnetic field is provided, through which the ore that it is desired to concentrate is dropped, or in which it is suspended. For experimental purposes, the rotor was removed from a suitable motor, and upon exciting the field and placing a dish of finely ground ore within the apparatus, a marked movement and separation of the mineral was evident.

Flotation Reagent—No. 1,417,261. R. Luckenbach, Brooklyn, N. Y., assignor to Luckenbach Processes, Inc., San Francisco. This covers the use of a reaction product of a bitumen and an alkali, together with sufficient acid to make the pulp non-alkaline but not sufficient to decompose the reagent. Patent No. 1,417,262 covers the use of the reaction product of an alkali and lac. Patent No. 1,417,263 covers the use of an alkali and a liquified, normally unsaponifiable, resin.

Crusher—Canadian patent No. 218,560. O. A. Ellis, San Francisco. A mill composed of a circular bed and saddle and a series of balls interposed between them, the effect being somewhat similar to that of a Chile mill, with balls instead of rollers as the crushing medium.

THE MINING NEWS

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Leading Events

IRON MINING in the Lake Superior district has quickened with the setting of ore prices following the recent reduction in freight rates.

Labor shortage is reported at some of the properties in the Michigan copper country. A growing scarceness of skilled workers is said to exist in various camps in the West also.

Nationalization of the Colorado River power project is opposed in the Southwest, prominent among the leaders being A. G. McKenzie.

Road improvements in Alaska depend to a large extent on the availability of funds. The matter has recently been before the Committee on Appropriations.

The Golden Cycle mine, at Cripple Creek, has been sold to the Carlton interests, its former owners. The deal is still to be ratified by the stockholders.

Lake Superior Iron Mining Comes to Life

Ore Prices Now Set Following Recent Reduction in Freight Rates—Labor Scarce in Places

The lowering of the freight rate on iron ore from the mines to upper Lake ports and the reduction in ore prices of 50c. per ton has stimulated shipping from all of the ranges of the Lake Superior district. The Interstate Commerce Commission, acting upon a petition of the shippers, ordered a reduction in ore rates of 10 per cent, effective July 1, but gave the roads the privilege of making the reduction June 19 if they cared to put the rate into effect earlier. Before this time the U. S. Steel Corporation announced a reduction of 10 per cent on its Duluth & Iron Range road and the Duluth, Missabe & Northern line. Most of the roads in the district followed the suggestion of the commission and put the new rates in force June 19. Dock charges have also been lowered 10 per cent at all ports on the upper Lakes.

It was almost an assured fact that the ore prices for 1922 would be lower than those of 1921, and it was generally believed that the cut would amount to 50c. The new schedule ranges from $5.05 for Mesabi non-bessemer to $5.95 for Old Range bessemer, the iron content being set at 55 per cent for bessemer and 51½ for the non-bessemer.

Soon after the new prices were announced, the Cleveland-Cliffs Iron Co., one of the largest of the independent operators, stated that a sale of 300,000 tons had been made. Other large sales have since been reported, and the ore business will be lively from now until the close of navigation in the fall. One Gogebic Range operator has announced that all ore in stock will be moved and that no limit has been placed on the amount to be mined.

There is a shortage of men on some of the ranges, and this condition will become more acute as more mines are opened. It is estimated that the iron ore mining business is now on a basis of about 75 per cent capacity, but this is certain to be increased as new sales of ore are made.

Estimates place the total tonnage to be moved this season at 45,000,000.

Westralian Mine Owners Anxious Over Wage Agreement

By Cable from Reuters to "Engineering and Mining Journal-Press."

Melbourne, June 14—The mine owners of West Australia are perturbed by the new three-year basic wage agreement, providing for a reduction in wages of only a shilling a day. It is feared that the award may react seriously on the industry.

Golden Cycle, at Cripple Creek, Returned to Carlton Interests

Sold by Vindicator to United Gold Mines Co.—Deal Subject to Stockholders' Approval

The sale of the property at Cripple Creek, Col., of the Vindicator Gold Mining Co., which includes the old Golden Cycle mine, to the United Gold Mines Co., a Carlton enterprise, has been announced, pending comfirmation of the stockholders of the Vindicator company. It is not known at this time whether the sale of this property is precedent to the liquidation of the Vindicator company, as it has holdings in other mining districts. The Golden Cycle mine comes back to the Carlton interests after having been separated from them since 1915, when it was sold to the Vindicator people. Cripple Creek mining men believe that the transaction will be followed by extensive low-level development of the property.

Labor Shortage Now Noticeable in Copper Country

Copper Range and Quincy First Affected—Automobile Manufacturing Centers Attracting Men

In the Michigan copper country, the Copper Range and Quincy companies are experiencing a labor shortage, but conditions in the north end of the Lake district are more favorable. Mohawk and Wolverine manage to keep their forces intact, while Calumet & Hecla, which is operating at less than 50 per cent capacity at the mine, has had no difficulty lately in filling all places. Ahmeek also has been able to increase its underground crew.

Copper Range, which has been hit harder than Quincy, will temporarily make up the difference in production caused by its labor shortage by transferring men from development work to mining. The exodus of labor from the mines is more pronounced than usual at this time of the year, owing to the prosperity in the automotive industry, which has attracted many men to Detroit and other industrial centers in Michigan. Though there have been rumors of wage increases, it is stated on reliable authority that wages cannot be advanced on 14c. copper.

Ray Hercules Cleaning Up

Men have been put to work cleaning up and making repairs underground at Ray, Ariz., by the Ray Hercules Mines Inc., this company being the reorganization of the Ray Hercules Copper Co.

Transvaal Gold Output for May

By Cable from Reuters to "Engineering and Mining Journal-Press."

London, June 19—The Transvaal Chamber of Mines advises that the gold output in the Transvaal during May totaled 629,786 ounces.

News from Washington

By PAUL WOOTON
Special Correspondent

Coal Miners' Position Improved

Pressure Being Brought on Administration to Arrange for Arbitration of the Strike

The time element is working in favor of the miners, insofar as the coal strike situation is concerned. The point is being reached where the Lake season must start. There are signs that some of the operators in Lake territory are weakening. The position of the strikers has been made much more tenable by the unpromising outlook for any early settlement in the anthracite fields. It is already apparent that there will be a shortage of anthracite coal next winter. It requires 260 working days as a minimum to meet the demands. There are only 240 working days left at the time of this writing.

Pressure already is being brought on the administration to arrange for the arbitration of the strike. Most of this pressure has its origin in the Northwest. That seems to be the only section of the country in which any nervousness is developing.

War Minerals Commissioner Recommends Two Awards

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended the following awards: Ashby, Long and Staples, West Montrose, Colo., $1,450.39; H. C. Stiles, Cartersville, Ga., $101.85 (additional award).

Disallowances were recommended as follows: Richard J. Fledderman, Yreka, Cal., no net loss; W. H. Weller, Jr., Birmingham, Ala., not commercial; Cia. Minera de Julinicum, Havana, Cuba, no reason for modifying former decision; Cia. Nacional de Cobre, Havana, Cuba, no reason for modifying former decision; Grant Chrome Co., Inc., Prairie City, Ore., not commercial; Casey, Brown and Saunders, Batesville, Ark., request for demand not established; Manganese Products Co., Modesto, Cal., no change in previous decision; J. T. Dobbins, Salt Lake, rehearing denied.

"Blue-Sky" Bill Deferred

Because of pendency of other legislation in the Senate, the Senate Committee on Interstate Commerce has decided to defer until the next session consideration of the Denison "blue-sky" bill recently passed by the House.

Snake Creek Tunnel Case Up Next Fall

The case of the Snake Creek Mining & Tunnel Co. (of Utah) vs. The Midway Irrigation Co., involving the right to percolating waters, was not reached by the U. S. Supreme Court during the term just closed. It will come up for consideration in October.

Abolish Discovery Requirement, Says Winchell

Give Locator Abundant Time to Find Ore—Prospector's Opportunites Limited Today—Mining Languishing in Northwest

From the stenographer's transcript of the recent hearing at which Horace V. Winchell appeared before the Committee on Mines and Mining of the House of Representatives, the following extract from the colloquy between Representative Rhodes, the chairman of the committee, and Mr. Winchell, is taken:

THE CHAIRMAN. In your opinion are the majority of the mine operators of the great mining Northwest in favor of this bill?

MR. WINCHELL. Decidedly and markedly so. The prospector objects to it simply because he is suspicious and uninformed, but the operators of experience are unanimously in favor of it. The operators are opposed to extra-lateral rights, and they recognize the futility of requiring a discovery before location.

THE CHAIRMAN. In speaking of opposition by the so-called prospectors, how do you estimate the weight of that opposition as compared with the opinions of those who favor the proposed law?

MR. WINCHELL. Numerically, so far as I have any record of their views, the prospector is multitudinous and the average mine operator has not said much about it. As a matter of fact, there is not one prospector now to ten a few years ago.

THE CHAIRMAN. That is the idea I had in mind and upon which I wanted your opinion. In truth and in fact, are there many real prospectors at this time?

MR. WINCHELL. I am in the country constantly. Whereas I used to spend night after night in the mining camps and talk with as many as thirty or forty prospectors, now I find only one or two or three in camp.

THE CHAIRMAN. Then, in your opinion, the old-time, bona fide prospector has to a very large extent disappeared in the mining regions of the great Northwest?

MR. WINCHELL. Yes, sir; because the opportunity for the discovery of mines by his own unaided efforts is largely a thing of the past. Today the prospector must be supported by a company or syndicate that is willing to spend a great deal of money to permit him to dig holes, run tunnels, etc. The prospector's knowledge, as a general rule, is not sufficient to support such a campaign of exploration.

THE CHAIRMAN. Is it your opinion that because of the universality with which prospecting has been carried on in the Northwest that there is no real, living necessity for the old-time mine prospector?

MR. WINCHELL. I am sorry to say that his opportunities today are limited as compared with twenty years ago.

THE CHAIRMAN. Are we justified in assuming that practically all discoveries have been made, and for that reason there is little left for the prospector to do in discovering surface outcroppings and other evidence of mineral deposits?

MR. WINCHELL. You are. There are within my acquaintance perhaps twenty exploration companies who have raked this country north, south, east, and west, from Alaska to the Rio Grande, searching for more mining. They started with the determination to examine everything and anything anybody could put up to them with a chance of discovering some mineral, but they have been unable to find anything.

THE CHAIRMAN. As a mining engineer, in your opinion, in what does the future success of our mining operations in this country lie—in the more rich vein deposits or in the larger and leaner deposits of mineral-bearing ores that carry a very low ore percentage?

MR. WINCHELL. In the latter, unquestionably, in a prepondering degree.

THE CHAIRMAN. If it is a fact that our future possibilities lie in the direction of developing the low-grade ores, then does the necessity for the old-time mining prospector still exist or has he practically accomplished his purpose?

MR. WINCHELL. Except as to Alaska his function has largely been exercised and used up.

THE CHAIRMAN. On the question as to the nature of our mineral deposits and their development, we take it that you are qualified to speak from the practical as well as the professional standpoint. What is the condition of the mining business in the Northwest today as compared with the period of, say, five years ago—are we going forward or backward?

MR. WINCHELL. As for exploration and the exploring of new mines, with the exception of very small and exceptional districts, we are languishing. The mining industry has made very little progress. Very few mines have been discovered within the last five or ten years.

THE CHAIRMAN. To what do you attribute that situation, to the exhaustion of the deposits or is it due to economic conditions?

MR. WINCHELL. No, sir; not wholly to one or the other, but very largely to the fact that the prospector has run over the country and cannot find anything more. And, moreover, the large companies hesitate to engage in a program of extensive and expensive investigation where the title is insecure. I have in mind a very valuable and promising placer deposit in Montana. The early mining in Montana was entirely placer mining and the gravel deposits passed underneath. Locations have been put on top of lava, which may be 200 ft. deep. Lawyers and capitalists came to Butte from the East and were prepared to undertake to develop and work those gravels which undoubtedly exist beneath that lava; however, after receiving advice from good, experienced mining men they went back home without investing.

THE CHAIRMAN. You have made a very important statement and one, I think, that deserves careful consideration. You state that the mining industry of the great Northwest is

languishing; what, if anything in your judgment, can be done by legislation to stimulate the mining industry?

MR. WINCHELL. Abolish the requirement of a discovery, and give the locator an abundance of time to discover ore. Do not limit the prospects to one claim. I would extend the five-year limit to at least seven years.

MR. SUTHERLAND. Do you not think that would serve for a wealthy organization in the East to get and hold, say, a whole county?

MR. WINCHELL. There is nothing in the present law to prevent it. You are not required to make a discovery.

MR. SUTHERLAND. The agitation of the community brings that about, does it not? A man who attempts to hold ground without sinking on it and making some demonstration is so unpopular that he finally has to do something.

MR. WINCHELL. Let me tell you—I have been to Alaska many times——

MR. SUTHERLAND. Yes, I know of your splendid reputation as a mining engineer and geologist.

MR. WINCHELL. Take camps like the one at Ely, Nev., where the Nevada Consolidated mines are. I happen to know that for twenty years there was a group of locators and prospectors that sat there upon that camp each year. They would shift around all the time. Bill Jones would locate No. 1 this year and Sam Smith would locate No. 2 this year. Next year Sam Smith would locate No. 1 and Bill Jones would locate No. 2. As a matter of fact they did not do anything to develop that camp. They just retarded the development of some of the largest copper mines.

THE CHAIRMAN. What, in your opinion, could be done by legislation to revive the mining industry? I infer that what you have said applies to the pending bill. In your opinion would the passage of the Arentz bill accomplish that purpose?

MR. WINCHELL. Yes, sir.

THE CHAIRMAN. That is the thing the committee is anxious to hear you on.

Gilsonite Land Bill Introduced

A bill providing for the location, entry, and patenting of lands in the former Uncompahgre Indian Reservation, in Utah, containing gilsonite or other like substances, has been introduced in the House by Representative Colton, of Utah. It provides that the lands and the mineral therein in the reservation which were specifically reserved for future action of Congress in the Act of March 3, 1903, as containing gilsonite, asphaltum, elaterite, or other like substances, which by the Act of 1903 were authorized to be sold and disposed of in tracts not exceeding forty acres, shall, unless otherwise reserved, be immediately open to settlement, location, occupation, and entry under all land laws, according to the character of the lands or of the mineral deposits in them.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended June 17 amounted to 201,750 fine ounces. This brings the total purchases under the Pittman Act to 114,380,506 fine ounces.

Silver Export Association Draws Comment

H. N. Lawrie Discusses Possibility of Breaking British Control of Market

The proposal to establish a silver export association has aroused considerable discussion in the silver camps, as is indicated by communications reaching the American Gold and Silver Institute. As the time grows nearer when the silver reserve, sold to Great Britain during the war, will have been replaced, attention is turning more and more to the problem of a more orderly marketing of the silver produced in the United States. One widely known mining engineer, in a letter to H. N. Lawrie, the managing director of the Gold and Silver Institute, speaking of the export association, says: "The object is worthy, but Britain controls India and the East. Her hold on silver is too tight to be broken."

In reply, Mr. Lawrie says:

"We have no precedent to guide us as to what the result would be in breaking the British control of the market by an organized effort in this country to control the sale of newly produced silver. We have, however, an example which occurred during the war which demonstrates that the holder of the silver controls the price.

"To satisfy an immediate need England came to the United States to secure the 208,000,000 oz. of silver, which was shipped to India. Had Great Britain failed in her efforts to satisfy this demand, there probably would have resulted an uprising in India which would have entailed a very heavy expense in money and lives and would have embarrassed Great Britain in her conduct of the war.

"As you know, the Pittman Act resulted from this condition and practically is a tri-partite contract between Great Britain, the United States, and the silver producers of the United States. The price of the silver sold to Great Britain under the terms of the Pittman Act was fixed by Congress only after consultation with the silver producers in the United States.

"It should be pointed out that Great Britain could obtain this large volume of silver in no other way than from the silver reserves in the United States. The conclusion, therefore, may be drawn from this incident that the buyer of silver could not exert so extensive a control over the price of silver should the bulk of the newly produced silver be marketed through a central organization which was properly financed, so that the silver could be held in storage awaiting the more active demands of the buyer, rather than forced upon the market because of the producer's need for immediate liquidation.

"The problem, therefore, is largely a question of the demand for silver, regardless of the channels through which silver may be shipped. Admitting that London is the world's financial center through which a large part of the Indian and Chinese trade is cleared, it still would be necessary for buyers to obtain newly produced silver wherewith to settle adverse trade balances in the Orient and to satisfy other currency demands."

Proposal to Pay Potash Bounty Acceptable to Producers

Senate Adopts Duty on Tungsten and Tungsten Products

Opposition from the farmers to the proposed duties on potash has been an important factor in inducing the Finance Committee of the Senate to revise further the tariff bill by placing potash on the free list and bringing in a proposal for a bounty which would offer a financial encouragement to the American industry equivalent to the protection carried in the bill passed by the House.

Chairman McCumber of the Finance Committee pointed out that if the bounty were made effective today, nothing would be paid out, as there is no potash being produced domestically. Even during the height of the war, when potash rose to $450 per ton, the maximum production was 54,000 tons, he pointed out. If the domestic production were to reach 50,000 tons a year during the five-year period over which the bounty would apply, Senator McCumber said, bounty payments would not exceed $2,500,000 for the first year; $2,500,000 for the second year; $2,000,000 for the third year; $1,500,000 for the fourth year, and $1,000,000 for the fifth year.

The representatives in Washington of the domestic industry seem to be entirely willing to accept the bounty proposal, but it is predicted in some quarters that the attitude of the potash producers will change. This is based largely on the experience with the sugar bounty. A direct payment of public money to an industry seems to arouse much greater resentment than does the payment of even a larger amount of tax at the custom house.

The Senate has adopted a duty of 60c. per lb. on the tungsten content and 25 per cent ad valorem on ferrotungsten, metallic tungsten, tungsten powder, tungstic acid, and other compounds of tungsten.

During the debate Senator Walsh, of Montana, inquired why a duty had not been placed on chrome ore. Senator Smoot, of Utah, said this is due to the fact that chrome ore production is scattered and because the American product is inferior to the imported ore.

Voluntary reductions in the duties on molybdenum and manganese alloys were offered by Chairman McCumber and Senator Smoot, for the Senate Finance Committee, and adopted. The duty on ferromanganese was cut from 2½ to 1⅝c. per lb., based on the metallic manganese content. Ferromanganese was defined as iron manganese alloys containing 30 per cent or more of manganese. The duty on manganese metal, silicon, boron and ferromanganese, and spiegeleisen containing not more than 1 per cent of carbon was fixed at 1⅝c. per lb. on the manganese content and 15 per cent ad valorem, instead of 20 per cent, as originally recommended by the committee.

News by Mining Districts

London Letter

The Zinc Corporation's Report—National Mining Corporation to Reorganize—South American Copper Syndicate's Smelter Ready This Fall

BY W. A. DOMAN

London, June 9—The Zinc Corporation's report for the calendar year 1921 is, to some extent, one of regret. Productive operations were restricted to the zinc-treatment department, mining being impossible except at a loss, owing to low prices ruling for lead and to a continuance of the unfavorable labor conditions at Broken Hill. The directors also regret the resignation of J. A. Agnew, on his acceptance of a directorship on the board of the New Consolidated Gold Fields. The financial policy adopted in the past has proved beneficial, for the cost of the tailings dumps having been written off, the profit earned from their treatment was more than sufficient last year to meet the fixed preference dividends. All arrears of the fixed preferential dividends have now been paid off. In the balance sheet the balance of claim against Aron Hirsch & Sohn stands at £62,206, but has since been settled for £25,000.

The total income of the corporation was £426,160, and the expenses were £304,659, leaving a working balance of £121,501. Appropriations, which included taxes, £22,232; preference dividends, £49,138; capital expenditure, £30,000; and depreciation, £10,000, amounted to £111,370, leaving a surplus on the year of £10,131.

Little work was done in the way of development, and this particularly applies to Nos. 11 and 10 levels, but 98.5 feet on No. 9 level averaged 11.4 per cent lead, 2.2 oz. silver, and 10.3 per cent zinc, over an average width of 5.5 ft. No mining having been done, the ore reserves remain as before, 2,115,700 tons, averaging 14.6 per cent lead, 2.6 oz. silver, and 9.4 per cent zinc, excluding the zinc lode. In the zinc concentrator 380,040 tons of tailings and slimes was treated and yielded 104,215 tons of zinc concentrate, 9,969 tons of lead concentrate, and 9,166 tons of zinc slime. The zinc concentrate, which was 27.4 per cent of the weight of ore, contained 82.1 per cent of the zinc, 51.4 per cent of the silver, and 39.9 per cent of the lead. The costs averaged 12s. 10d. per ton treated, against 14s. 7d. in 1920.

The National Mining Corporation has, so far, had a disastrous career. Its issued capital is £1,238,572; its investments have cost £1,055,629, and the balance sheet made up to Dec. 31 last shows a depreciation of £639,110. This is not all loss, and part of it will be recovered. Meantime, it is necessary to reorganize the capital, and it is proposed to cut down the nominal value of the shares from £1 to 8s, with 4s. paid, thus reducing the liability from 10s. to 4s.

The Mount Elliott position is still far from clear. Contradictory statements have been made from time to time concerning the provision of fresh capital. "First they would, and then they wouldn't." Now, owing to failure to find new money, brokers in Paris who had speculated on the expansion of operations have got into difficulties, and have had to be helped. It is not easy to arrive at the true position.

A long report upon the property of the South American Copper Syndicate, Ltd., by Charles H. Stewart, has been issued to the shareholders. The report states that within the company's forty square miles of freehold, the known orebodies occur in a zone three and one-half miles long, but all of the present workings are within an area of less than one square mile, of which the Main Area mine has been developed and partly expoited over a total length of 2,220 ft. The computation of "probable" ore, 603,350 tons, deals only with the most southerly 1,200 ft.

The new smelter is expected to be in operation in September, and an output and treatment of 6,000 tons of 5-per cent ore per month is estimated to yield, with copper at 13.15c. per lb. net, a monthly profit of £7,211. Each variation of 1c. in price represents £1,286 per month on this output, facilities for increasing which are to be provided.

JAPAN

March Output of Metals Reported by Department of Commerce

Tokyo, May 9—The total output of metals during March, according to the returns of the Department of Agriculture and Commerce, was as follows:

Classes	*March*	*First Three Months 1922*
Gold	189,689 *momme* (*a*)	505,290 *momme* (*a*)
Silver	1,169,146 *momme* (*a*)	8,169,339 *momme* (*a*)
Copper	7,478,163 *kin* (*b*)	20,086,623 *kin* (*b*)
Iron	3,252 tons	8,119 tons
Coal	3,211,734 tons	6,155,971 tons
Petroleum	141,264 *koku* (*c*)	408,582 *koku* (*c*)

(*a*) *Momme* = 0.1325 oz.; (*b*) *kin* = 1.325 lb.; (*c*) *Koku* = 39.7033 English gallons.

Compared with the returns for the corresponding period of the preceding year these figures show an increase of 15.4 per cent in gold, and of 0.5 per cent in coal, and a decrease of 8.8 per cent in silver, 7.1 per cent in copper, 19.6 per cent in iron and 12.7 per cent in petroleum.

Mount Lyell's Nodulizing Plant Burned

By Reuters Agency

The nodulizing plant of the Mount Lyell Mining & Ry. Co., Ltd., Mount Lyell, Tasmania, was destroyed by fire June 3. The loss is not expected to affect smelting operations seriously, as the erection of the new Dwight Lloyd sintering plant was completed May 20 and is now in operation.

Johannesburg Letter

Testimony on Conditions Taken by Mining Industry Board

BY JOHN WATSON

Johannesburg, May 9—The feature of the week has been the continued sittings of the Mining Industry Board. In the course of these, Errol Hay, technical adviser to the General Mining and Finance Corporation (the "Albu" group) said that the Albu group controls six producing and four non-producing mines. If the price of gold fell to normal without any corresponding reduction of costs, only one mine, the Meyer and Charlton, would be able to continue work, and the remaining mines, which employed 994 whites, would have to close down. Even at the present price of gold, 93s. 6d., and under December costs, three of the mines, employing 596 whites, would be unpayable, and a fourth (the Aurora West) would show only a nominal profit.

The statement given in the following table, prepared by the Witwatersrand Native Labor Association, was handed in by the Chamber of Mines, showing the total number of natives employed, exclusive of natives re-employed at the same mine on the expiration of their original contracts:

	East Coast (Portuguese Territory)	British South Africa	Total
1917	57,296	153,260	210,556
1918	56,796	141,170	197,966
1919	63,144	167,286	230,430
1920	76,439	134,216	210,655
1921	64,577	149,487	214,064

Among the natives who came to the mines under indenture the average period of indenture of East Coast "boys" is 313 shifts, and the average period among British South African natives is only 166 shifts.

A fall of rock in the Battery section of the West Rand Consolidated on May 2 injured sixteen natives.

A fire recently broke out in the Kimberley shaft of the Roodepoort United Gold mine.

The Transvaal gold output for April was declared by the Chamber of Mines on May 10. Thirty-eight mines on the Rand and a smaller number in the outside districts have produced 511,388 oz. of fine gold of a value of £2,352,155. As compared with December 1921, the latest previous complete month worked, the April return shows a decrease of nearly £1,000,000 in value. Among the largest individual mines, Government Areas produced 47,283. Crown Mines 43,988, and New Modder, 28,801 oz.

It is satisfactory to note that natives are returning freely to the gold mines, the net gain for the first ten days of May being 7,900. For April, the net gain was 13,741. Roughly speaking, for every ten natives employed underground one white man is engaged in supervision.

ONTARIO

Dome Doubles Dividend Rate—Lake Shore Showing Well

Cobalt — Nipissing's cash in bank, bonds and bullion at June 10 were $4,510,129.20, During May the Nipissing mined ore of an estimated net value of $197,715 and shipped bullion of an estimated net value of $250,750. The month's silver production was valued at 72c. per oz. Underground work was heavier than usual, and the mill treated more than an average tonnage of good ore.

The shaft on the J. B. 4 La Rose Extension claim is dewatered almost to the 350 level, where considerable exploration work will be done.

The O'Brien mine, which sent a car of 64,000 lb. of ore to the Deloro smelter, was the only shipper in the week ended June 9.

Kirkland Lake—The sinking of the Bidgood shaft to 600 ft. is now proceeding.

The Lake Shore mine continues to show excellent results, and it is understood that its treasury contains $350,000, as operations so far this year have been profitable and no dividends have been paid as yet this year.

Porcupine—Dome's dividend rate has been doubled to $2 per share a year. The increase was announced at the annual meeting of the shareholders, on June 13 in Toronto. The new rate will be effective with the next dividend, which is payable July 20. Two dollars per share yearly will mean the disbursement of $953,334 in dividends. Each dollar repayment of capital calls for $476,667, and shareholders are assured of $1 capital repayment during the fiscal year, and good prospects of another $1. Last year's net profit was $1,244,000 and the present net profits are running at the rate of $2,000,000 yearly. It was reported at the annual meeting that the net profit in May was $183,548, with recovery of $11.11 per ton.

It is stated by a director of the Porcupine V. N. T. that no arrangements have been made for refinancing of that property.

BRITISH COLUMBIA

Work Resumed at Rock Candy Mine

Grand Forks—Operations are being resumed at the Rock Candy flourspar property of Consolidated Mining & Smelting Co. The plant has been inactive for some months, but it is understood that a contract has been entered into for disposal of the product, which insures operation for a considerable period, and it may be that production will be maintained indefinitely.

Sandon—The Noble Five property has been examined lately. It is reported that negotiations for its sale are being conducted.

Kaslo—One of the leasers working in the upper levels of the old Whitewater mine has opened up a splendid showing of high-grade zinc ore. Although the discovery has been made only recently, the tonnage now in sight is estimated as being in excess of 2,000. Samplings over a 7-ft. face give returns of 58 per cent zinc, the highest grade of zinc yet met at any mine in the Slocan or Ainsworth Mining Divisions, with the possible exception of the Lucky Jim, which long held the record as being the highest grade zinc property in British Columbia.

New Denver—Following the announcement that the Consolidated zinc plant at Tadanac is in a position to accept custom zinc ores, a considerable tonnage of that material is beginning to move from various properties in the district. Most of this is an accumulation of concentrate turned out over two years ago. An instance of this is furnished by the Silversmith mine, at Sandon, which has had about 2,000 tons of zinc concentrates piled up for some time awaiting a market. The Rambler-Cariboo, above Three Forks, and the Bosun, near this point, have also had accumulations. While the returns from such material will not reach a high figure per ton, realization of some income from this source will prove an acceptable aid to finances after the period of prolonged depression.

Nelson—On account of claims made that the act incorporating professional mining engineers of this province has been a handicap to prospectors and small operators, the Mining Association of the Interior of British Columbia has asked the provincial government to amend the act of incorporation so that mining, milling and smelting operations should not come under its provisions.

MEXICO

Money Reported to Be Still Scarce in Republic

No pronounced improvement can be noted in general conditions in Mexico in the last thirty days, says Assistant Trade Commissioner Bushnell in a cable despatch to the Department of Commerce. The banks report that collections remain only fair and deposits have not increased during the month. Money is still scarce, with no relief in sight.

Consul Thomas D. Bowman, at Monterey, reports that money is still scarce in that district. As an example, a mining company recently sold its notes bearing 12 per cent interest at 80c. on the dollar in an effort to obtain capital to finance the reopening of the mine, which is a proven property of value. The banks in the Monterey district are practically limiting their operations to dealing in exchange. In Guadalajara, the money situation is much the same, according to Consul Andrew J. McConnico. In some cases, interest rates are as high as 3 per cent per month, whereas, ordinarily, the rates vary from 18 to 24 per cent a year.

The banks are having difficulty there in making collections and for that reason are not eager to grant loans. It is asserted by some persons that fully eighty per cent of the outstanding loans of the Guadalajara section have been granted extensions, owing to the inability of the debtors to discharge their obligations, which in turn is due mainly to the prevailing low prices of all farm produce.

A contributing cause to the scarcity of money is the general hoarding of gold. Many of the more conservative depositors have withdrawn their funds from Guadalajara banks and have refused to redeposit them. The sudden changes in the money market in Mexico City which have occurred shortly before the monthly period for the payment of oil taxes will be avoided, it is hoped, by a recent circular issued by the Mexican Treasury Department requiring payments, heretofore made on the 25th of each month, in three installments, thirty per cent on the 10th of each month, thirty per cent on the 20th, and forty per cent on the 25th.

The demand for merchandise has not yet been stimulated, so that importers are placing orders for only the most necessary replacements.

Durango

Bacis Company Working 300 Men—Knotts Tests Gardenia Claim at Guanacevi

BY ALBERTO TERRONES

Santiago Papasquiaro — The Bacis country is reported quiet. The Bacis Gold & Silver Mining Co. had to stop work during the revolution. It resumed early in 1917. W. R. Bawden is in charge as general manager. At present 300 men are working at the mines and mill. The property is equipped with a 200-hp. low-pressure turbine, and is short of power, owing to the dry weather. The mill is being remodeled, and new machinery is on the way. Forty stamps and Wilfley tables are in use. The sands are leached and the slimes treated by cyanidation. The capacity of the mill, after the improvements are finished, will be 3,000 tons per month. The mill products are turned into bullion and shipped in the form of silver bars, about thirty bars being shipped every month. The mill extraction ranges from 85 to 90 per cent, and the milling cost is 6 pesos per ton. The Bacis ores are not amenable to flotation. The mine is 1,500 ft. above the mill, and the ores are transported by cable to the mill. The mining cost is 5 pesos per ton. No timbering is required and the mine is dry. The average grade of ore is 13 oz. of silver per ton.

Guanacevi—Gerónimo Elizondo is working the Mexican mine where a bonanza was recently discovered. He has already invested 80,000 pesos in development work.

E. F. Knotts and Manuel González Peña will undertake bore-hole prospecting on the Gardenia claim, west of the Soto Group, to determine the nature of the deposits in the western part of San Pedro.

ARIZONA

Nationalization of Colorado River Power Project Opposed by A. G. McGregor

Phoenix—A. G. McGregor is leading an attack upon the proposed nationalization of the Colorado River water-storage and hydro-electric development opportunities. He is making a campaign throughout Arizona in favor of a plan in which the state is expected to finance the great works needed and to benefit especially from the sale of power. He intimates that the necessary funds could be secured by means of state bond issues, with low interest charges, these issues backed by Arizona power consumers. It happens that these power consumers mainly would be mining corporations, which now are paying anywhere from $50 to $150 per horsepower per year. Up to 200,000 hp. Mr. McGregor figures that profit could be secured at $25 per hp. a year. Up to 500,000 hp. he would start the cost at $15 and from there up to 800,000 hp. at $12. At such cost, he expresses belief that electric current profitably might be used for the reduction of ores and in metal manufactures, as well as in ordinary mechanical and manufacturing industries. He disclaims any intention, however, of confining the benefits to Arizona, and suggests that power users in California or other states might join the power users' association. It is proposed to create an association that would market the bonds, do the engineering, provide and market the power and pay the costs, including interest, until the enterprise should become productive. It is assumed that under this plan the state eventually would be paid out and would have the water power works as a continuing asset of tremendous value.

Mr. McGregor believes the Lee's Ferry dam site, now claimed by the Edison Co., to have features superior to those of the Boulder Canyon dam site, which is favored by the Reclamation Service. He estimates that at least 6,000,000 hp. can be secured within the Grand Canyon, though the process of its utilization would be a continuous one as necessity arose for generation of power.

Globe—Inspiration is employing more men (about 2,000) than ever before in its history. Miami has a payroll of 1,300 men and Old Dominion about 750. The total number employed in the two camps is about 5,000.

Arizona Commercial is operating at about three-quarters capacity and producing smelting ore and concentrates at the rate of 750,000 lb. a month.

Inspiration is starting a new town for its employees near its main shaft, about three miles from Miami.

Ray—There is a local report that the mill of the new Ray Hercules Mines, Inc., successor to the Ray Hercules Copper Co., is to be enlarged to 1,800 tons' capacity and the process changed somewhat.

CALIFORNIA

Conditions in the Dredging Districts—North Star Producing Steadily—Randsburg Continues Active

San Francisco—Gold dredging on the Trinity River, Trinity County, is in a more or less stationary condition. Two new dredges are under construction. One is being erected by L. Gardella on a bar on the south side of the Trinity a mile and one-half below Lewiston. The other dredge is being erected by the Lewiston Dredging Co. at the Martin Ranch above Lewiston. The pit has been excavated, derrick erected, and hauling of the machinery and hull materials is under way. The area to be dredged is approximately 700 ft. wide and a mile long. The Valdor dredge has been dismantled and its parts are to be used in the construction of the new dredge. The only dredge in operation is the 11-ft. boat of the Trinity Dredging Co. operating about five miles above Lewiston.

The Pacific Dredging Co., a subsidiary of the Yukon Gold, has shut down its all-steel dredge at Carrville and will dismantle it preliminary to shipping it to the Federated Malay States for use in tin dredging. The Estabrook dredge at Trinity Center has been shut down for a considerable period and may be started again within several months. Thus one dredge is in operation, one is being dismantled, one is shut down, and two dredges are under construction. In the Shasta County center near Redding, L. Gardella has two dredges operating on Clear Creek, and the American Gold Dredging Co. has one dredge in operation on the Sacramento River not far from Redding.

Small operations in Siskiyou, Shasta, and Trinity counties continue. In the Washington mine, at French Gulch, a rich strike has been reported. L. W. Vaughn has located six copper claims on the Pit River, twenty miles from Copper City, in the Canyon Creek mining district. The Gold Dollar Mining Co. has been incorporated to work a mine near the old town of Shasta.

At Grass Valley, the North Star is reported to be producing at the rate of $100,000 per month. At the Alcalde mine a drift is being driven and a shaft will soon be sunk. At the Bath mine, in the Rough and Ready district, a 500-ft. adit has been started to intersect the orebody at a depth of 700 ft. below the present workings. A new ledge has been struck in the Finney mine, near Downieville.

The Red Wing mine, near El Dorado, will be put in operation. The plant is being put in condition.

The California Rand Silver Co. extended its development 1,572 ft. and mined 9,330 tons of ore during May. The capacity of the mill is to be increased to 200 tons per day. During May, 172 tons of concentrate were shipped to the smelter. Twenty cars of ore and four cars of concentrates are expected to be shipped in June.

NEVADA

Rochester Silver's May Profits About $10,000

Peavine—In the Standard Metals mine the vein has been cut on the 400 level and drifted on, along the foot wall, for 35 ft. in ore of $20 grade. The oreshoot is said to be showing up better on the 400 than on the 300 level.

Rochester—The May bullion production of the Rochester Silver Corporation was $48,903, and net profits will be about $10,000. Tonnage treated was 4,615, of an average value of $13.32 per ton. The Rock tunnel has cut the footwall branch of the West vein 70 ft. below the nearest workings, and where cut the vein shows 3 ft. of ore of better than milling grade.

Eureka—Work has been resumed in the Eureka Holly and Bullwhacker workings of the Eureka Holly Consolidated company. Repair and development work has been started and a 100-ton ore shipment is to be sent to an Idaho plant which uses the oil flotation process similar to the one which the Eureka Holly Consolidated Company expects to use in its new mill, now under consideration.

The Eureka Croesus has resumed work after a shutdown of about three weeks due to hoist troubles.

Pioche—The Bristol Silver Mines Co. is to increase its underground operations materially. The shaft is completed; also the 380-ft. tunnel which makes connections with the old 100 level on which there still remains a large tonnage of silver-copper ore. About sixty tons daily is being mined from the 900 level.

The Amalgamated Pioche M. & S. Corporation has recently completed the shipment to the Garfield smelter of 400 tons of iron concentrates stored from prior operations at the mill. The material was shipped to the A. S. & R. at Garfield, Utah.

The Highland district is active owing to the increased shipments from the Mendha mine, now producing about fifteen tons daily. High-grade silver-lead ore is being loaded for shipment from the Comet district, where considerable new work is being done. Properties now working include the Stella, the Lyndon, and the Panaca mines.

COLORADO

U. S. G. S. to Survey Ashcroft-Woody Section—Operations at Cripple Creek

From Our Special Correspondent.

Aspen—G. F. Loughin, of the U. S. Geological Survey, together with several assistants, will arrive in Aspen soon, to begin a survey of the section between Ashcroft and Woody preliminary to mapping the district. Special attention will be given the Richmond Hill and Aspen districts.

The investigations are for the purpose of completing the Spurr survey of what is generally termed the Aspen district, but was discontinued at a point a little north of the Little Annie. Much

importance is placed upon developments awaiting a more complete knowledge of geological conditons of Richmond Hill, on which are located the Hope, Little Annie, Hurricane, and other important mines, as well as the territory south to Ashcroft, including the Mount Hayden section.

Cripple Creek—The following is a list of the principal producing mines in the Cripple Creek district. Practically all those operating and producing some ore: Ajax, Cresson, Granite, Modoc, Dr. Jack Pot, Mary McKinney, Portland, Vindicator, Rose Nicol, United Gold Mines, Jerry Johnson, Isabella, Stratton Cripple Creek Mining & Development Co., Gold Sovereign, and Dante.

The tonnage at the Golden Cycle mill has increased from 19,000 tons to a present average of 22,000 tons per month.

The Independence mill of the Portland Gold Mining Co. has been treating from 20,000 to 30,000 tons of low-grade ore per month. There is also quite a good deal of activity in the way of surface prospecting and leasing in general. The Cresson production at present is about 10,000 tons per month.

UTAH

Utah Metal & Tunnel Co. May Resume Operations Soon

From Our Special Correspondent.

Eureka—Ore shipments from the Tintic district for the week ended June 10 amounted to 150 cars, compared with 168 cars the week preceding, this falling off being due to the temporary suspension for repairs at the Tintic Standard mill, and, at the Grand Central, for repairs to the cable. Shippers were: Chief Consolidated, 52 cars; Tintic Standard, 36; Iron Blossom, 11; Eagle & Blue Bell, 10; Victoria, 9; Colorado, 9; Grand Central, 6; Gemini, 4; Mammoth, 4; Centennial-Eureka, 2; Bullion Beck, 2; Dragon, 1; Sunbeam, 1; Swansea, 1; Julia Lane, 1.

Park City—Shipments for the week ended June 10 amounted to 4,299 tons, compared with 2,505 tons the week preceding. The large tonnage is due to heavy shipments from the Ontario tailings dump. Shippers were: Ontario, 2,044 tons; Silver King Coalition, 888; Park-Utah, 870; Judge, Daly, and Daly West, 497. Now that the new mill of the Silver King Coalition is operating, the mining of high-grade ore from the new oreshoots is less hampered by accumulations of milling ore in the mine. During the period when no ore could be milled, there was stored in the mine about 6,500 tons of low-grade ore.

At the Park-Utah's annual meeting, held in New York, directors elected were: G. W. Lambourne, G. D. Blood, J. S. Bransford, W. M. Bransford, Moylan C. Fox, Otto Luedeking, and Edward Rosenbaum.

Bingham—According to a recent statement by the Utah Metal & Tunnel Co. this company may resume operations as soon as there is prospect of profitable operation.

MICHIGAN

Calumet & Hecla Tonnage Increasing—Developments in Mayflower-Old Colony More Encouraging

By M. W. Youngs

Houghton—Through the practice of close selection, Calumet & Hecla rock is averaging almost 40 lb. to the ton, which is considerably better than in 1921 or 1920. Tonnage from the conglomerate shafts is slowly but steadily increasing. Eight shafts are hoisting rock.

Extensive repairs which have been under way for more than a year in No. 1 shaft, North Kearsarge branch of the Osceola Consolidated, are nearing completion. No decision, however, has been reached as to the resumption of mining.

Allouez remains idle, but the mine is being kept fairly dry and could be put in readiness within a few weeks' time.

Developments in Mayflower-Old Colony are more encouraging at present than for some time. The favorable mineralization in the 1,400 and 1,700 level drifts continues and it would appear that many of the difficulties encountered in the faulting of the ground have been largely overcome. At the bottom level a drift is proceeding north in a well-defined vein, well charged with copper.

Ahmeek is averaging about 1,600 tons a day from its operating shafts, Nos. 2 and 4. Nos. 1 and 3 shafts are still held in reserve.

Isle Royale now has some miners on contract and since the adoption of this system the rock tonnage has increased, enabling the mill to operate on schedule, four days and nights each week.

Menominee Range

Caspian Mine Working—Homer Closed—Chapin and Aragon Shipping

Iron River—Operations have been resumed at the Caspian mine of Pickands, Mather & Co. This is the largest underground mine in the Iron River field.

A shortage of men is reported in Iron River and in some of the other mining towns in the Michigan district. Many departed during the dull period and few have returned.

The Homer mine, operated by the Buffalo Mining Co., has been closed because of litigation started by the fee holders. It is claimed that the ore has been improperly mined, and that sand has been allowed to mix with it so that a large quantity now in stock is almost unsalable. The miners have been transferred to the company's Cardiff property, in the same district.

Iron Mountain—Shipments from stockpile and pocket have been started at the Oliver Iron Mining Co.'s Chapin and Aragon mines. The company is also shipping from all of its other mines in Michigan.

Crystal Falls—The M. A. Hanna Co. has suspended all work at the Carpenter mine. The dull condition of the ore market is given as the reason.

MINNESOTA

Vermilion Range

Chandler Mining Co. at Full Capacity—Armstrong Bay to Make First Shipment

Ely—The Chandler Mining Co., operating the Chandler No. 1 mine, has started production at capacity by additional crews. It is expected that the daily hoist will be approximately 1,000 tons per day.

The employment situation has practically reversed itself, and the companies are seeking labor for their underground and pit crews. At present approximately 9,000 men are employed, compared with 16,000 men in normal times.

Tower—The Chippewa Iron Mining Co. expects to make its initial shipment this season from its Armstrong Bay property. The mine is practically ready for production and the four and one-half mile spur from the Duluth & Iron Range R.R. is almost completed.

Mesabi Range

Hibbing—The Oliver Iron Mining Co. has increased its ore operations in this district. At present three shovels are loading ore in the Hull-Rust pit, one in the Sweeney pit, one in the Morris pit, one in the Sellers pit and two in the Kerr pit.

The Pickands, Mather Co. has also started underground operations at the Albany and Utica mines. The Utica is one of the largest underground mines on the range.

The Webb mine, operated by the Shenango Furnace Co., has started to hoist ore. The company has also put its screening plant in operation.

Operations have been curtailed at the Leetonia mine, of the Interstate Iron Co. owing to the inability of the furnaces to which it ships, to obtain a sufficient quantity of coke due to the coal strike. This is the first known instance where the coal strike has affected operations on the Mesabi Range.

Nashwauk—The York mine, which is operated by the Coates & Tweed Co. has started ore shipments from its open pit. The concentrator has also been started.

Bovey—The Pickands, Mather & Co. has started work at its Danube property, both in the open pit and at its washing plant. Two steam shovels are now loading ore, which is being sent to the concentrator for treatment.

Coleraine—The Canisteo and Holman pits have again been placed in operation by the Oliver Iron Mining Co. Two steam shovels have been placed in the ore at both of the properties. To handle the wash ore from the properties in this district, two units of the large Trout Lake concentrator have been put in operation.

Eleveth—The Bowe-Burke Iron Co. has started shipments from its stock piles at the Mariska and Burns properties. Regular production from underground operations has not begun.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
15	13.50	30.75	31.50	5.75	5.60	5.375@5.40
16	13.50	30.875	31.50	5.75	5.55@5.60	5.375
17	13.50	30.875	31.50	5.75	5.55@5 60	5.35@5.375
19	13.50	30.50	31.125	5.75	5.55@5.60	5.35
20	13.50	30.75	31.50	5.75	5.55@5.60	5.35
21	13.375@13.50	30.75	31.375	5.75	5.50@5.60	5.35

*These prices correspond to the following quotations for copper delivered: June 15 to 20 inc., 13.75c.; June 21, 13.625@13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
15	61⅞	62⅛	69	151¼	152¼	24⅜	23⅝	27¾	27¾
16	61⅞	62⅛	69	152½	153½	24⅝	23½	27⅞	27¾
17	...	...	...	.....	.....	.....	.....	...	...
19	62¼	62½	70	152⅝	153⅜	24⅝	23⅝	28	27⅞
20	62⅛	62½	69	152⅜	153⅜	24½	23⅝	27⅞	27¾
21	61¾	62⅛	69	152⅜	153⅜	24⅜	23⅝	27¾	27⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
15	447¼	99⅜	71⅞	36	19	440½	99⅜	70⅞	36⅛
16	446¾	99⅝	71⅜	35¾	20	439¾	99⅜	70⅝	36⅛
17	443	99⅝	71	36	21	442	99⅜	70⅜	35¾

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, June 21, 1922

The week has again been a quiet one, with a tendency toward price recessions. Without a doubt, the continuance of the coal strike is having the effect of making consumers whose fuel supply is not assured somewhat hesitant in providing for future requirements. The general industrial condition of the country continues favorable, and metal is going well into consumption.

Transatlantic freight rates continue unchanged at $4 per long ton to the principal European ports with the exception of Antwerp and Rotterdam, to which the rate is $3.50. Transpacific rates to Hongkong and Kobe are $8.

Copper

Domestic buying has been on an extremely small scale during the week, this being responsible for the decline in prices. Some producers with little copper to sell are continuing to maintain the 13½c. delivered price, but most selling agencies have quoted and obtained 13.75c., at least up to Monday night. Some consumers have been actively scouting for 13.5c. copper, but so far we have no reports of any producer or dealer willing to come to that level where the average freight rate applies. Yesterday and today, however, at least one producer was willing to come to the 13.625c. delivered price, and some sales have been made at that figure. There is no particular pressure on the market and the reaction is not likely to carry the price much below present levels.

Export demand has been fair at prices from 14½c. c.i.f. received by the Copper Export Association to about three-eighths cents less, obtained by outside interests.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5.75c., New York.

Lead has continued in good demand, and the price quoted by the leading interest has generally obtained in the East. Corroding grades have been held at one-tenth of a cent premium, and several sales of good tonnages have been made. In the middle West the price has shown a tendency to sag. Most of the business has been booked at about 5.60c. St. Louis and 5.70c. Chicago, though one producer was willing to sell at 5.55c. St. Louis up till yesterday, and did some business at that level. Today lead might be obtained at 5.50c. in this direction, but other quotations as high as 5.60c. are still being made.

Some excitement was caused by the reported arrival of 700 tons of lead from Liverpool on the "Adriatic" Monday. However, this was really remelted shrapnel balls, and it is said that it should have been listed as antimonial lead or type metal.

Zinc

The market has been quiet, with one of the leading interests exerting some pressure to sell. The price therefore has declined somewhat, though the statistical position of the metal is excellent and a decline of any proportions is not to be expected. High-grade continues to be quoted at 6.25c. delivered in the East, and New York prices on Prime Western are 35 points in advance of the St. Louis quotations.

Tin

Violent fluctuations in sterling exchange have had an unsettling effect on the tin market during the last few days. Consumers have not been buying actively, but business has been of fair proportions, especially between traders. Tin for actual spot delivery has been closely held at premiums of from one-eighth to one-quarter cent over what metal for shipment in a few days has brought. Electrolytic has brought the same prices as Straits. Tin for forward delivery (three months) has been quoted at approximately the same prices as those asked for near-by,

though a discount of one-eighth cent has, in some instances, been made.

Arrivals of tin, in long tons: June 15th, London, 250; Straits, 25; 17th, Straits, 2,475; 19th, Liverpool, 125.

Gold

Gold in London: June 15th, 92s. 4d.; 16th, 92s. 3d.; 19th, 93s. 6d.; 20th, 94s. 5d.; 21st, 93s. 3d.

General stock of money in the United States, June 1, 1922: Gold coin and bullion, $3,774,470,231; standard silver dollars, $378,371,851; subsidiary silver, $271,658,822; United States notes, $346,681,016; Federal Reserve notes, $2,511,810,960; Federal Reserve Bank notes, $87,607,400; National Bank notes, $755,900,702; total, $8,126,500,982. Circulation per capita, $48.78. The gold and silver reserves increased $15,000,000 in the last month, and the outstanding notes decreased $50,000,000.

Foreign Exchange

Sterling has fluctuated widely during the last week, following the political news from Europe. On Tuesday, June 20, francs were 8.71c.; lire, 4.89c.; marks, 0.3175c.; and Canadian dollars, 99.04c.

Silver

Silver prices continued downward last week on account of the fall in sterling and Chinese exchange rates. The market has been featureless, but the tone is steady despite lower prices. This steadiness, however, is due more to lack of offerings than to the strength of the demand for silver.

Mexican Dollars — June 15th, 55; 16th, 54⅝; 17th, 54¼; 19th, 54¼; 20th, 54; 21st, 53¾. These quotations refer to the old Mexican peso or "Mexican Sun Dollar." The current silver peso contains only 12 grams of silver and is worth about 27c. when silver is 70c. per oz. Quite a large quantity of the old pesos are still being received in the New York market from the Mexican border.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.10@5.125c. W.C.C., 5.75@6.25c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.20@$1.25 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Palladium—$55@$57.50 per oz.

Platinum—$87.50 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $55.30.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of June 3.

Metallic Ores

Lake Superior Iron Ore—Mesabi nonbessemer, $5.05, f.o.b. Lake Erie docks.

Chrome, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published June 3.

Zinc and Lead Ore Markets

Joplin, Mo., June 17.—Zinc blende, per ton, high, $33.85; basis 60 per cent zinc, premium, $34; Prime Western, $33@$32.50; fines and slimes, $32@$30; average settling price, all grades of blende, $31.54. Calamine, 40 per cent zinc, $15@$18; average, $17.98 per ton.

Lead, high, $77.20; basis 80 per cent lead, $78@$80; average settling price, all grades of lead, $74.53 per ton.

Shipments for the week: Blende, 11,850; calamine, 71; lead, 1,164 tons. Value, all ores the week, $461,870.

Around 2,000 tons of reserve lead was purchased in midweek on the basis of $80 per ton, continuing in strong demand. Shortage of Western production is placing a heavy toll on this district and Southeast Missouri to supply a growing demand.

Zinc blende was advanced another half dollar on practically all grades, and purchases are up to the average, with the demand continuing strong.

Platteville, June 17.—Blende, basis 60 per cent zinc, $35 per ton. Lead ore, basis 80 per cent lead, $77.50 per ton. Shipments for the week: Blende, 325 tons; lead ore, none. Shipments for the year: Blende, 7,270 tons; lead ore, 977 tons. Shipped during the week to separating plants, 766 tons blende.

Non-Metallic Minerals

Feldspar—Canadian feldspar, 13 per cent K_2O and 65 per cent SiO_2, continues at $10 per net ton, f.o.b. Quebec quarry.

Graphite—Ceylon lump, first quality, 7@10c. per lb., f.o.b. N. Y.; chip, 5@6.5c. per lb.; dust, 4@5c. per lb.; amorphous crude, $18@$70 per ton; flake, 6@9c. per lb.

Talc—High-grade foundry talc, $20 per ton, or $18 in carload lots, f. o. b. Virginia mills.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Talc** are unchanged from the prices published June 3.

Mineral Products

Arsenious Oxide (White Arsenic)—7.25@7.50c. per lb.

Copper Sulphate — 6.25c. for large crystals. Prompt shipment scarce.

Sodium Nitrate—$2.50 per 100 lb. ex vessel, Atlantic ports.

Potassium Sulphate and **Sodium Sulphate** are unchanged from quotations of June 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $67.50 per gross ton, f.o.b. furnace. English, $67.50, c.i.f. Atlantic seaports. Spiegeleisen 19@21 per cent, $36, f.o.b. furnace; 16@19 per cent, $35.

Ferrosilicon—10 to 15 per cent, $38@$40 per gross ton, f.o.b. works; 50 per cent, $58@$60; 75 per cent, $115@$120.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published June 3.

Metal Products

Copper Sheets—New York base, 20.50c. per lb.; wire, 15.75c.

Nickel Silver—26.75c. per lb, for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 17.75c.; rods, 14.75c. per lb.

Lead Sheets and **Zinc Sheets** are unchanged from the quotations published in the June 3 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from the prices appearing in the issue of June 3.

The Iron Trade

Pittsburgh, June 20, 1922—The turnover in the steel market, in point of tonnage, has continued to decrease, and the market is quiet. In the general market situation an outstanding feature is the firm attitude the Steel Corporation occupies against further price advances, now that prices are at a fair level relative to production costs. The latest illustration is the opening of the American Sheet & Tin Plate Co.'s books on June 15 for August and September sheet business at unchanged prices, based on 3.15c. for common black.

Steel ingot production is at the rate of about 39,000,000 tons a year, against a rate of 35,000,000 tons April 1, when the coal strike started, and production of less than 20,000,000 tons in 1921. Non-union strikers in the Connellsville region are now returning to work in greater numbers, while there is expectation that efforts will soon be made to start some of the union mines in the Pittsburgh district.

Pig Iron—The market remains stagnant. Prices are unchanged, but have become more or less nominal, at $25 for bessemer and basic and $24 for foundry, f.o.b. valley furnaces.

Coke

Connellsville Coke—Furnace, $7@$7.25; foundry, $7.50@$7.75.

COMPANY REPORTS

Utah Copper Co.

During the first three months of the year 1921, operations of the Utah Copper Co., at Bingham Canyon, and Magna and Arthur mills, near Salt Lake City, were conducted at about 50 per cent of capacity; on April 4 the properties were closed down for the remainder of the year.

The consolidated statement of assets and liabilities of the Utah Copper Co. and the Bingham & Garfield Ry. Co. is as follows:

ASSETS

	Dec. 31, 1921		Dec. 31, 1920	
Mining and milling properties and equipment	$29,670,247		$29,678,350	
Railway property and equipment	6,913,894		6,904,423	
Less reserve for depreciation	7,520,307		6,289,408	
		$29,063,834		$30,293,366
Investments		5,837,860		5,837,860
Deferred charges to operations		9,943,260		9,861,569
Copper Export Association—suspense		977,936		
Current assets				
Cash	$4,123,350		$1,964,392	
Cash due for copper deliveries	822,634		354,731	
Marketable securities	7,199,918		10,148,370	
Accounts receivable and prepaid insurance	201,118		425,881	
Metals on hand and in transit	3,350,695		10,597,103	
Materials and supplies	3,674,093		3,707,630	
		19,371,808		27,198,108
		$65,194,696		$73,190,902

LIABILITIES

Capital stock outstanding		$16,244,900		$16,244,900
Current liabilities				
Accounts payable	$257,340		$880,758	
Accrued charges	62,920		1,126,012	
Reserve for taxes, etc	2,189,979		2,186,439	
		2,510,238		4,193,208
Surplus from sale of securities		8,290,620		8,290,620
Surplus from operations		38,148,938		44,462,173
		$65,194,696		$73,190,902

The statement of operations for the year 1921 follows:

Operating revenue		
Copper produced—24,511,593 lb. @ 12.929c	$3,169,057	
Gold produced—7,040.7 oz. @ $20	140,815	
Silver produced—65,929 oz. @ 99.646c	65,695	
		$3,375,568
Operating expenses		
Mining and stripping	$612,162	
Ore delivery—mine to mill	234,455	
Milling	1,440,753	
Treatment, freight and refining	806,341	
Selling commission	23,954	
		3,117,666
Net income from operations		$257,902
Miscellaneous income		524,187
Charges against income		
Shutdown expense	$1,124,726	
Depreciation	1,019,758	
Loss on copper sold during shutdown	214,842	
Loss on bonds sold and miscellaneous charges	480,871	
		2,840,197
Net loss to surplus account		$2,058,109

SURPLUS FROM OPERATIONS

Balance, Dec. 31, 1920	$44,177,423
Net loss for year (exclusive of depletion)	2,058,109
	$42,119,314
Less—capital distributions	4,061,225
Balance, Dec. 31, 1921	$38,058,089

Distributions were made to stockholders during the year aggregating $2.50 per share, or $4,061,225, which brings the total so distributed to Dec. 31, 1921, to $115,570,887.50.

The cost of producing copper, applying credit for precious metals but making no allowance for depreciation, was 11.57c. per lb., compared with 12.21c. for the preceding year. Total ore milled amounted to 1,220,700 tons.

Copper Range Co.

The directors of the Copper Range Co. present the following consolidated statement of the operating companies (Copper Range Co., Champion Copper Co., Trimountain Mining Co., Copper Range R.R. Co., and Atlantic Mining Co.) for the year ended Dec. 31, 1921:

31,753,738 lb. of copper sold for		$4,205,558.72
916,000 lb. unsold, estimated at 13c		119,080.00
32,669,738 lb. produced. Average price 13.238 c. per lb		$4,324,638.72
Interest		127,395.45
Atlantic Mining Co. income from rents, and interest		5,271.81
		$4,457,305.98
All expenses		3,683,752.77
		$773,553.21
Taxes paid by mining companies		301,679.65
		$471,873.56
Operating income, Copper Range R.R. Co	$240,800.84	
Less interest on bonds	114,000.00	
		126,800.84
		$598,674.40
Deduct one-half of net mining profit of Champion Copper Co. which belongs to the St. Mary's Mineral Land Co		363,489.11
Operating income		$235,185.29

ASSETS:

Cash		$299,528.72
U. S. Liberty Loan bonds		1,979,000.00
Federal Land Bank bonds		54,000.00
Copper delivered and not paid for		378,023.12
Copper on hand		2,129,499.65
Copper Range R.R. Co. bonds		870,000.00
Michigan Smelting Co. stock		340,000.00
Balance due from U. S. Government account railroad guaranty		92,966.29
Supplies at mines	$546,767.14	
Cash at mines	71,955.55	
		618,722.69
Accounts receivable		247,412.39
Insurance prepaid		1,251.65
Miscellaneous securities		47,743.62
		$7,058,148.13

LIABILITIES:

Current indebtedness at mines	$142,497.40	
Accounts payable	19,340.06	
		161,837.46
		$6,896,310.67
Less one-half Champion		1,220,855.95
Net excess of assets		$5,675,454.72

The Copper Range Co. now holds in its treasury 97,231 shares Atlantic Mining Co. stock; 99,690 shares Trimountain Mining Co. stock; 50,000 shares Champion Copper Co. stock; and 42,443 shares Copper Range R.R. Co., the entire stock issued.

A comparative statement of operations covering Baltic, Trimountain, and one-half of Champion, which the Copper Range property embraces, is as follows:

	1921	Average for Ten Years, 1912 to 1921 Inclusive
Tons of ore stamped	604,878	890,368
Lb. refined copper produced	22,310,085	26,290,697
Lb. refined copper per ton stamped	36.88	29.52
Cost of copper per lb., cents	12.74	11.87
Price received per lb., cents	13.19	19.75
Profit per lb., cents	0.45	7.88
Cost of mining, smelting, freight, marketing	$2,842,196.77	$3,118,377.84
Net earnings Copper Range Co.	$235,185.29	$2,104,890.49

No dividends were paid in 1921. Total dividends to date, $26,998,345, payments being made in every year from 1905 to 1920 inclusive, except in 1914. Operations were on a profitable basis during the last half of 1921, and conditions are continuing to improve according to the report. The annual report includes the financial details of the operations of the subsidiary companies.

Michigan Copper Mining Co.

All operations at the property of the Michigan Copper Mining Co., at Rockland, Mich., continued suspended throughout the year 1921. Assets and liabilities as of Dec. 31, 1921, were as follows:

ASSETS		
Cash	$566.18	
Treasury stock	2,922.00	
Cash and supplies at mine	28,553.87	
Accounts receivable	6,766.10	
Unexpired insurance	417.54	
		$39,225.69
LIABILITIES		
Indebtedness at mine	$22,477.95	
Accounts payable	32,140.71	
Loans	355,000.00	
		409,618.66
Excess of liability		$370,392.97

The stockholders will again be asked to formulate a plan of refinancing.

Income for the year totaled $7,095.16 and expenses, $44,833.46.

Candelaria Mines Co.

The financial statement of the Candelaria Mines Co., with general offices at Candelaria, via Mina, Nev., as stated in the annual report for 1921, is as follows:

ASSETS:			
Current assets			
Cash on hand and in banks		$46,482.32	
Accounts receivable		203.61	
Construction and boarding-house supplies		2,134.61	
			$48,820.54
Prepaid charges			228.03
Deferred charges—discount on note payable			50,000.00
Capital assets			
Mining properties, claims and leases		$2,028,473.09	
Plant and equipment	$59,577.68		
Office furnishings	1,086.78		
	$60,664.46		
Less depreciation	9,592.14		
		51,072.32	
Mill construction, begun Dec., 1921		1,863.93	
Development, sampling, and experiments, administrative and general expense		260,913.93	
			2,342,323.27
			$2,441,371.84
LIABILITIES			
Current liabilities			
Wages payable		$557.33	
Accounts payable		9,194.12	
Operating funds advanced		1,529.39	
Note payable, due Nov. 1, 1922		23,700.00	
			$34,980.84
Accrued interest on note due Nov. 1, 1922			237.00
Deferred credits—suspense			265.00
Fixed liabilities			
Note payable, due November, 1924			100,000.00
Capital stock authorized, 3,000,000 $1 shares		$3,000,000.00	
Less unissued stock of which 369,111 $1 shares are under option at $1 per share for three years to the Rochester Silver Corporation		694,111.00	
			2,305,889.00
			$2,441,371.84

Money was secured from interests closely associated with the Rochester Silver Corporation, for the purpose of putting the Candelaria property into production. The total cost to Candelaria will be $400,000, payable in three years from Nov. 15, 1921, with no interest for the first eighteen months, and thereafter at 6 per cent. A share option was also given as mentioned above.

A 300-ton milling plant is now being constructed and is expected to be completed in July, 1922. The engineers estimate 610,000 tons of milling ore available, sufficient to last six years and pay a profit of $1,600,000. The report discusses geological conditions and other topics of interest in more detail than usual. In fact, it is stated that it will be the policy of the present directorate to see that shareholders are kept fully and correctly informed, at frequent intervals, of all matters connected with the operations. This warrants our publishing the directors' names, *cum laude:* C. D. Kaeding, president, of San Francisco; S. Rossiter, vice-president, of New York; F. M. Manson, of Reno; O. W. Jones, of Chicago; and J. C. Peebles, assistant secretary and treasurer, of Reno.

Round Mountain Mining Co.

During 1921, the lode mining operations of the Round Mountain Mining Co., operating in the Round Mountain district, sixty miles northeast of Tonopah, Nev., were carried on by lessees, but 110,700 cu.yd. of placer gravel was hydraulicked by the company. This yielded 9,009 oz. of bullion, having a value of $120,845. The total operating costs were $65,650 and the net realization, $55,195. The gross value recovered represented $1.09 per cu.yd., production cost was 59c. per cu.yd.; and realization, 50c. per cu.yd.

The balance sheet is of Dec. 31, 1921, is as follows:

ASSETS	
Properties, water rights, and titles	$1,508,142.82
Mine and milling plants, equipment and buildings	12,633.76
Hydraulic pipe lines, dams and placer equipment	121,814.15
Stocks owned	33,901.36
Store supplies on hand	22,618.19
Cash on hand	6,038.68
	$1,705,148.96
LIABILITIES	
Capital	$1,500,000.00
Profit and loss	113,527.72
Bills payable	60,000.00
Accounts payable	31,621.24
	$1,705,148.96

The lode lessees mined and milled in the company's mill, 1,936 tons of ore averaging $49.91 per ton; tailings averaged $1.47; and the net value $48.44, representing an extraction of 97.06 per cent. Total mining costs were $42.15 per ton, made up of labor, $33.58; milling and marketing, $4.20; and supplies, compressor, insurance, and miscellaneous items, $4.55. The company received in royalties, $11.24 per ton, and for use of the company mill, $1 per ton.

The operating profit before depreciation and depletion was $45,768.10. Not less than 200,000 tons of gravel should be hydraulicked this year, according to the report, and at a less cost per yard than in any previous year. The company is managed by the same men who are at the head of the Fairview Round Mountain company, 20 per cent of the issued stock of the Fairview company being held by the Round Mountain company. Louis D. Gordon, is president, and Gibson Berry, general superintendent.

Magma Copper Co.

The balance sheet of the Magma Copper Co., operating at Superior, Ariz., as of Dec. 31, 1921, was as follows:

ASSETS		
Mining claims and development		$927,755.30
Mining and milling property		563,927.99
Investments in Magma Ariz. Ry. Co., Patagonia-Superior Copper Co., Apache Powder Co., and Sacaton Copper Co.		385,326.57
Current and working assets		
Refined copper at 17.25c. per lb.	$1,379,217.36	
Raw ore—cost of extraction	8,794.48	
Supplies at book value	159,585.14	
Cash, accounts receivable, and notes	34,985.04	
		1,582,582.02
Deferred assets		53,703.92
Deferred expenses		128,541.36
		$3,641,837.16
LIABILITIES		
Capital stock		
Authorized, 300,000 $5 shares	$1,500,000	
Less unissued 60,000 shares	300,000	
		$1,200,000.00
Current and accrued liabilities		929,695.26
Contingent reserve for claims		82,180.02
Surplus		
Balance, Jan. 1, 1921	$1,730,439.63	
Adjustments for prior years	647.78	
	$1,729,791.85	
Deficit for 1921	299,829.97	
		1,429,961.88
Total		$3,641,837.16

The net cost of producing copper during the three months that the company operated, not including depletion, but including depreciation and all overhead charges and deducting gold and silver credits, was 14.91c. per lb. The ore mined amounted to 21,445 tons, and the net smelter production was 2,028,889 lb. of copper, 59,794.48 oz. silver, and 818.88 oz. gold. The reasonably assured copper sulphide ore now amounts to 1,505,000 tons, averaging 5.6 per cent copper, 3 oz. silver, and 0.025 oz. gold.

MINING STOCKS

Week Ended June 17, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	63½	60½	60½	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	4½	3½	3½	.....	....
Alloues	Boston	26½	25	26	Mar. '19	1.00
Anaconda	New York	52½	50	51	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4¼	3¾	3¾	.....	....
Ariz. Com'l	Boston	9¼	9	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*19	*16	*18	.....	....
Bingham Mines	Boston	15½	15½	15½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	...	...	65½	Mar. '22, Q	0.50
Calumet & Hecla	Boston	275	270	270	June '20, Q	5.00
Canada Copper	N. Y. Curb	*36	*30	*30	.....	....
Centennial	Boston	11	10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	37½	35¼	35½	Mar. '21, Q	0.50
Chile Copper	New York	21	19	19¼	.....	....
Chino	New York	30¼	28	28¼	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*28½	*28½	*28½	.....	....
Con. Arizona	N. Y. Curb	*5	*3	*3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅜	*45	*60	.....	....
Copper Range	Boston	45	43½	43½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1 1/16	1 1/16	1⅛	.....	....
Davis-Daly	Boston	8¼	7⅛	7⅛	Mar. '20, Q	0.25
East Butte	Boston	11	10½	10½	Dec. '19, A	0.50
First National	Boston Curb	*75	*75	*75	Feb. '19, SA	0.15
Franklin	Boston	2⅜	2 1/16	2⅜	.....	....
Gadsden Copper	Boston Curb	*95	*81	*81	.....	....
Granby Consol.	New York	29⅜	27⅛	29	May '19, Q	1.25
Greene-Cananea	New York	32¼	30¼	30½	Nov. '20, Q	0.50
Hancock	Boston	†3½	†2½	3	.....	....
Howe Sound	N. Y. Curb	3¼	3	3¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	41¼	39½	39½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8½	†7½	8	Sept. '20, K	0.25
Isle Royale	Boston	24	23	23	Sept. '19. SA	0.50
Kennecott	New York	35⅜	32⅛	33	Dec. '20, Q	0.50
Keweenaw	Boston	2⅜	2⅛	2⅛	.....	....
Lake Copper	Boston	4⅜	4⅛	4⅛	.....	....
La Salle	Boston	1⅛	1⅛	1⅛	.....	....
Magma Copper	N. Y. Curb	30	28½	30	Jan. '19, Q	0.50
Majestic	Boston Curb	*12	*10	*10	.....	....
Mason Valley	Boston	1⅜	1⅜	1⅜	.....	....
Mass. Consolidated	Boston	3½	3¼	3¼	Nov. '17, Q	1.00
Miami Copper	New York	29⅜	27⅛	28¼	May '22 Q	0.50
Michigan	Boston	3¼	2⅛	3¼	.....	....
Mohawk	Boston	65	62½	62½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	9½	9¼	9¼	.....	....
Nevada Consol.	New York	17¼	16½	16¾	Sept. '20, Q	0.25
New Cornelia	Boston	19	18¼	18½	May '22, K	0.25
North Butte	Boston	13¼	12¼	12½	Oct. '18, Q	0.25
North Lake	Boston	...	...	...	.....	....
Ohio Copper	N. Y. Curb	*8	*8	*8	.....	....
Old Dominion	Boston	27	24	26	Dec. '18, Q	1.00
Osceola	Boston	35	33¼	33¼	June '20, Q	0.50
Phelps Dodge	Open Mar.	†185	†175	...	Apr. '22, Q	1.00
Quincy	Boston	45¼	44	44	Mar. '20, Q	1.00
Ray Consolidated	New York	17	16¼	16⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	2	1⅞	1⅞	.....	....
St. Mary's Min. Ld.	Boston	47½	45	45	Apr. '22, K	2.00
Seneca Copper	Boston	....	....	14	.....	....
Shannon	Boston	1	*85	*85	Nov. '17, Q	0.25
Shattuck Arizona	New York	10½	9⅜	9⅜	Jan. '20, Q	0.25
South Lake	Boston	†1⅛	†1	1⅛	.....	....
Superior & Boston	Boston	1 1/16	1⅛	1⅛	.....	....
Tenn. C. & C. cfs.	New York	11⅛	10½	11	May '18, I	1.00
Tuolumne	Boston	*70	*65	*68	May '13,	0.10
United Verde Ex.	Boston Curb	29½	27	29	May '22, Q	0.25
Utah Consol.	Boston	3½	3	3	Sept. '18,	0.25
Utah Copper	New York	65⅜	62	62⅛	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅜	1⅛	1 1/16	Dec. '17,	0.30
Victoria	Boston	1⅜	1⅛	1⅛	.....	....
Winona	Boston	2	1⅞	2	.....	....
Wolverine	Boston	14	11⅞	13	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	17	16	16¾	Mar. '19,	0.50
Internat. Nickel, pfd	New York	81	79	81	May. '22, Q	1.50
LEAD						
National Lead	New York	94⅛	90½	91	Mar. '22, Q	1.50
National Lead, pfd.	New York	†113	†109½	109⅜	June '22 Q.	1.75
St. Joseph Lead	New York	15	14⅜	14⅜	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	*50	*25	*25	.....	....
ZINC						
Am. Z. L. & S.	New York	18¼	16	16	May '20,	1.00
Am. Z. L. & S. pfd.	New York	44	42	42	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅛	7	7	June '18,	0.50
Butte & Superior	New York	28⅛	26	27	Sept. '20,	1.25
Callahan Zn-Ld.	New York	8⅞	8	8⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	144½	142	142	May '22, Q	2.00
Yellow Pine	Los Angeles	*51	*51	*51	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

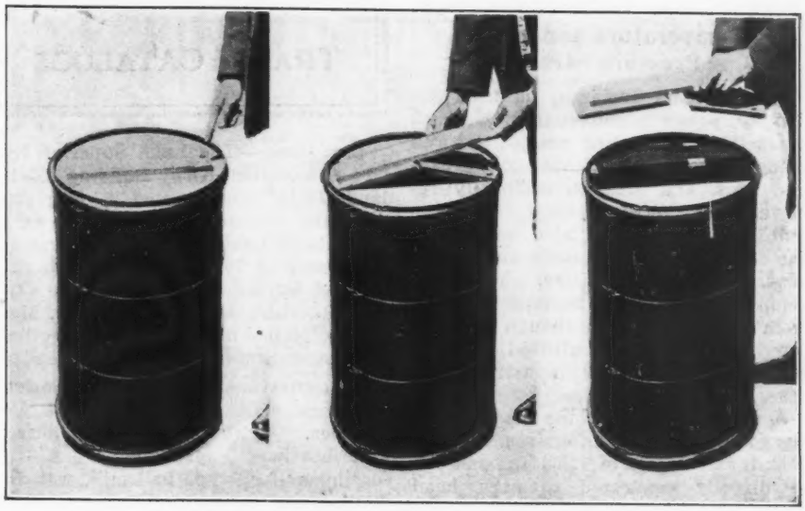
Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	1⅛	1⅛	1¼	.....	....
Atlas	Toronto	*25	*19	*24	.....	....
Carson Hill	New York	12	12	12	.....	....
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Apr. '22, Q, X	$0.10
Dome Mines	New York	30	27¼	28	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*18	*18	*18	.....	....
Golden Cycle	Colo. Springs	*81	*81	*81	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*6	*6	*6	Dec. '19,	0.05
Gordon Murray	Toronto	*31	*29	*30	.....	....
Hollinger Consol.	Toronto	9.25	9.05	9.20	June '22,	0.05
Homestake Mining	New York	71	69½	69½	May '22, M	0.25
Keora	Toronto	9⅛	8	8½	.....	....
Kirkland Lake	Toronto	*42	*38	*39	.....	....
Lake Shore	Toronto	2.25	2.16	2.16	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18.00	16.50	16.25	May '22, K	0.05
Porcupine Crown	Toronto	*21½	†20	*20	July '17,	0.03
Porcupine V. N. T.	Toronto	*23	*21	*22	.....	....
Portland	Colo. Springs	†*30	†*23	*25	Oct. '20, Q	0.01
Schumacher	Toronto	*68	*63½	*67	.....	....
Silver Pick	N. Y. Curb	*17	*17	*17	.....	....
Teck Hughes	Toronto	*47	*44	*45½	.....	....
Tom Reed	Los Angeles	*51	*49½	*50	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1 1/16	1⅛	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*6	*6	*6	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*7	*7	.....	....
Wright-Hargreaves	Toronto	2.75	2.50	2.75	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1	*80	*89	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1¼	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*30½	*27½	*30	May '20, K	0.03
Coniagas	Toronto	1.25	1.25	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*15	*12	*15	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3¼	3⅜	Apr. '22, Q	0.12½
La Rose	Toronto	*33½	*31½	*31½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	...	...	*25	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.04	.95	1.00	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6¼	6¼	Apr. '22, Q, X	0.30
Ontario Silver	New York	8	8	8	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*29½	*20	*29½	Jan. '20, K	0.04
Trethewey	Toronto	*4¼	*3½	*4¼	Jan '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*17	*15	*15	.....	....
Cash Boy	N. Y. Curb	*6	*6	*6	.....	....
Dolores Esperanza	N. Y. Curb	2⅛	1⅞	2⅛	.....	....
El Salvador	N. Y. Curb	*4	*4	*4	.....	....
Jim Butler	N. Y. Curb	..	..	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	..	..	*5	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅞	1 1/16	1 1/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*79	*76	*78	.....	....
Tonopah Extension	N. Y. Curb	1⅜	1 1/16	1⅛	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅜	1 1/16	1⅜	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1	1 1/16	June '22, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*7	*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*95	*95	Dec. '20,	0 15
Chief Consol.	Boston Curb	5 1/16	4⅛	5 1/16	May '22, Q	0.05
Consol. M. & S.	Montreal	22½	22	22	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.00	†1.40	...	July '20, Q	0.10
Daly-West	Boston	1⅜	1⅛	1⅛	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3½	†3	3½	Apr. '21, K	0.05
Electric Point	Spokane	8¼	5	5	May '20, SA	0.03
Federal M. & S.	New York	11	11	11	Jan '09,	1.50
Federal M. & S. pfd.	New York	50	45	45	June '22, Q	1.25
Florence Silver	Spokane	*22½	*22½	*22½	Apr. '19,	0.01½
Grand Central	Salt Lake	†*62	*60	*60	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6⅜	6¼	6⅜	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*30	*27	*27	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.50	†2.20	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*⅛	*18	*22	June '21, I	0.02
Prince Consol.	Salt Lake	*5½	*4½	*5½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*4½	*6½	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*9	*7	*8	.....	....
Standard Silver-Ld.	N. Y. Curb	*10	...	*20	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	...	*8	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.62	2.50	2.60	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.12½	2.12½	2.12½	Dec. '21, Q	0.05
Utah Apex	Boston	3	2⅜	2⅜	Nov. '20, K	0.25
Gilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	48⅛	42⅛	44⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	...	...	57⅛	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	76	75⅛	75⅛	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	24⅛	21⅛	22⅛	Nov. '19, Q	1.00
Texas Gulf	New York	47	44⅛	44⅛	June '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	61⅜	57⅛	57⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	98	97	98	June '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	†95½	†91	93⅛	Apr. 22, Q	1.50
U. S. Sm. R. & M.	New York	41⅛	40	40⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	†49¼	†46	47⅛	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

A Knock-Down Barrel Which Is Useful in Transporting Bulky Products

Recently there has been developed a knock-down metal barrel for use in transporting all sorts of bulky materials. The barrels are suited to a great variety of purposes where the package cost can be reduced by returning the barrels and re-using them. In the mining industry they will be found useful in transporting ores, concentrates, and mattes, and also where goods are carried on animals. A keg is made specially for this purpose with an inside measurement of 11x17 in. and a total weight of 9¼ lb. Barrels are also made for carrying lime, cement, and asphaltum.

The principal feature of the barrel is the locking barrel head, which permits inserting or removing the head of a barrel in the croze without expanding the croze of the barrel. The barrel consists of a thin sheet of black iron or galvanized iron, according to the products the barrel is to contain, which is fastened with wires that are easily detachable. After being used to transport materials the barrels can be knocked down by cutting or opening the small tie wires holding the wire hoops. The heads and wires of seven barrels may be placed in the eighth barrel while the seven metal sheets are nested for return.



Knock-down metal barrel and method of opening

Sheets of seven barrels nested for shipment. Upright barrel contains heads and wires for seven barrels

In assembling, the forms are put on a mandrel the exact size of the inside of the barrel. Clamps close the sheet in place, the joint is made, wire hoops are put on, and the head is put in place. The barrel is manufactured by the Knapp Metal Barrel & Package Co., 812 Hearst Bldg., San Francisco, Cal.

A New Radio-Phone Receiver

There has recently been produced and placed on the market, under the trademark name "Audiophone," a loud speaker horn for receiving radio concerts. Although this device is a comparatively new development in the radio field, it is stated to be the result of thirty years' experience in the development and manufacture of precision recording and indicating instruments and six years' research work in sound reproduction. The result of this research produced a loud speaker which gives a large volume of amplified sound, and yet faithfully reproduces the original.

The audiophone is of a compact and artistic design finished in bronze. The bell of the horn is 15 in. in diameter. The complete design of the bell, neck, and electrical characteristics of the receiver box, together with materials used, is such as to produce a loud speaker. Songs, speeches, announcements, conversation, and instrumental music are reproduced by it with a clearness and audibility which has not been possible with the majority of radio receivers. It is rugged and simple in construction, thus insuring durability. It requires no separate storage battery for magnetizing current. To make the horn suitable for all types of radio amplifier circuits, a transformer is mounted in the base which provides the impedance about equal to that of the vacuum tube amplifier, into the plate circuit to which the horn is connected. When connected to a third stage of amplification operating on 100 v. or over, the volume of sound is great enough to be easily heard in a room seating 500 persons. For smaller rooms good results are obtained from the audiophone when connected with a two-stage amplifier.

One watt is required by the audiophone to give full volume. Therefore, the amplifier must be so designed as to have a high voltage in at least the last stage, or, better still, to operate with high voltage on all tubes. The device is manufactured by the Bristol Co., Waterbury, Conn.

Associations To Meet at Chemical Exposition

Several leading associations of the chemical industry have definitely arranged to meet at the Eighth National Exposition of Chemical Industries which will be held during the week of Sept. 11-16, at the Grand Central Palace, New York. The special meetings which have already been scheduled to be held at the Grand Central Palace during the week of the exposition include a meeting of the American Ceramic Society, the Technical Association of the Pulp and Paper Industry, and the Salesmen's Association of the American Chemical Industry. Other technical and commercial groups connected with the chemical and allied industries are also expected to meet at the time of the exposition, but definite arrangements have not as yet been made.

Small Steam Turbines for High Temperature and High Pressure Steam

Small steam turbines, as used for driving power plant auxiliaries, such as exciters, circulating pumps, hot well pumps, boiler feed pumps, coal crushers, fans, and stokers, ordinarily receive, and should demand, little attention. They should also be able to use steam at high pressure and superheat, and for their size, should develop the maximum amount of work from the steam, even though the latter is subsequently utilized in feed water heaters or for industrial purposes.

A velocity stage turbine has been designed to meet these requirements. It is built in sizes up to 1,200 hp., and can be directly connected to high head centrifugal pumps, blowers and compressors, to alternators and to small direct-current generators, or by means of speed-reducing gears, to medium size alternators and direct-current generators, to large centrifugal pumps and blowers, to belt pulleys and rope sheaves, and to other slow and moderate speed machinery.

To adapt it for operation with steam of high pressure and superheat, the steam chest and nozzles are placed in the casing cover, so that the bearings are not subjected to high temperatures. As the steam is completely expanded in the nozzles, the turbine case contains steam at exhaust pressure only. For all steam temperatures above 450 deg. F. and for steam pressures above 210-lb. gage, the steam chest, governor valves, emergency governor valve casing and strainer casing are made of steel.

The wheel carries two or more rows of buckets, depending upon the speed and steam conditions. The buckets are drop-forged from materials best suited to resist the corrosive and erosive action of steam, and are secured to the rim of the wheel by bulb shanks in such a way that individual buckets can be removed without disturbing others. The steam discharged from the first row of buckets passes through guide vanes, which direct it upon the succeeding row. These guide vanes are held in removable steel segments attached to the nozzle plates, so that it is a comparatively simple matter to replace them if damaged or worn by long use with wet steam.

The admission of steam to the steam chest is controlled by a speed governor, which acts upon a double-seated valve. Where the volume of steam to be handled is large, or the speed is high or close speed regulation is desired, the governor is of the Jahns type, mounted on a vertical spindle, which is driven by turbine shaft through a worm gear.

This turbine is being placed on the market by the De Laval Steam Turbine Company of Trenton, N. J., primarily to meet the demand for reliable and efficient auxiliary turbines where high steam pressures and superheats are used.

TRADE CATALOGS

Iron Ores — The Lake Superior Iron Ore Association, Kirby Building, Cleveland, Ohio, have issued a fifty-page pamphlet containing the average cargo analyses of Lake Superior iron ores for the season of 1921. These include ores shipped by the operators on the Cuyuna, Baraboo, Mayville, Gogebic, Marguette, Menominee, Mesabi, Vermilion, Michipicoten, and Sudbury districts.

Concentrating Machinery.—Cottrell Engineering Co., 207 Mesnager St., Los Angeles, Cal., illustrates and briefly describes in a 6-pp. leaflet a 3 x 3 ft. continuous-feed type ball mill, wet and dry concentrators, an improved Blake type crusher, and the Cottrell vibrating screen. The dry concentrator shown occupies 3 x 8 ft. floor space and has a capacity of thirty to thirty-five tons per day.

Steam Engines.—The Stumpf Una-Flow Engine Co., Inc., 206 E. Genesee St., Syracuse, N. Y., has issued in "Lefax" form a 4-pp. leaflet descriptive of the una-flow engine which claims a reduction of the following losses common to other reciprocating steam engines: cylinder condensation, volume of clearance, throttling, friction, leakage of valves and pistons, heat radiation, and incomplete expansion.

CONSTRUCTION NEWS

Granby Consolidated Planning 1,000-Ton Concentrator

Plans for the construction of a 1,000-ton mill for the Granby Consolidated Mining, Smelting & Power Co., of British Columbia, are being prepared, according to the company's annual report. Surrounding the several orebodies of the Hidden Creek mine, states the report, are envelopes of siliceous ore merging from high into low-grade reserves. Such ores are said to be not suitable for economic semi-pyritic smelting, but are recoverable at a profit through methods of concentration which have been worked out in the company's pilot mill, and definite flow sheets have been established for the particular ore in question. Ability to mine at one time and separately treat the two classes of ore encountered will effect economies not obtainable by divided operations.

Georgia Copper Co. Will Add to Present Plant

The Georgia Copper Co., of Lincolnton, Ga., states that it has resumed operations and that it expects to erect a smelter in the near future. It also intends to install a ball mill.

Iron Ore Washing Plant for Tod-Stambaugh Co.

The Tod-Stambaugh Iron Co. is considering the building of an ore washing plant at its Billings mine on the Mesabi Range, Minn., in the near future. The upper part of the orebody consists of washable ore, this having been demonstrated by experiments. The lower part of the deposit is a direct shipping ore, which is being developed.

Construction of Argonaut Mill Begun

Active construction of a mill at the Argonaut mine, east of Kirkland district, Ontario, was begun June 10, and its completion well before the year is out will add a new producer to the list of Ontario gold mines. The property is operated by the Argonaut Gold Mines, Ltd., Royal Trust Building, Montreal, Quebec.

Eureka Holly Plans Remodeling of Mill

The Eureka Holly Consolidated Mining Co., Eureka, Nev., whose workings include the Eureka Holly and Bullwhacker, is planning to remodel the Eureka Holly mill. Installation of flotation is being considered. A test shipment was recently sent to an Idaho plant.

Erection of Two Gold Dredges Under Way

Two new gold dredges are under construction on the Trinity River, in Trinity County, California. One is being built by L. Gardella on a bar on the south side of the Trinity, one and a half miles below Lewiston. The Lewiston Dredging Co. is erecting the other at the Martin Ranch, above Lewiston. The dredge pit has been excavated, the derrick erected, and hauling of the machinery and hull materials is progressing.

Candelaria Mill to Be Finished in July

About seventy-five men are employed by the Candelaria Mines Co., of Candelaria, Nev., and the 300-ton plant should be completed in July, as originally planned. The electric power line from Mina will be finished at about the same time. Underground workings are being put into condition for production and development.

Empire Consolidated Installs Marcy Rod Mill

In addition to the large installations made by the Phelps Dodge Corporation, the Empire Consolidated Mining Co., at Empire, Col., has installed a rod mill of the open-end discharge Marcy type for crushing to 40 mesh. This mill, though not manufactured by the Mine & Smelter Supply Co., is made under license from that company and according to Marcy specifications.

Volume 113 June 24, 1922 *Number* 25

ENGINEERING & MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, *Editor*

TENTH AVENUE AT 36TH STREET, NEW YORK CITY

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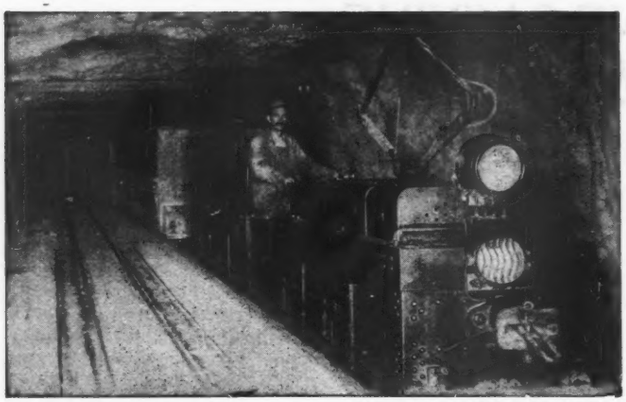
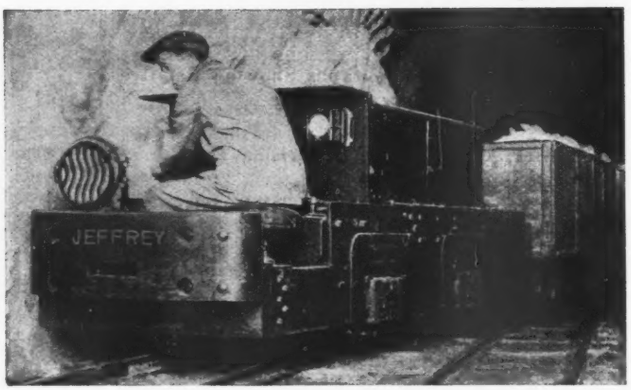
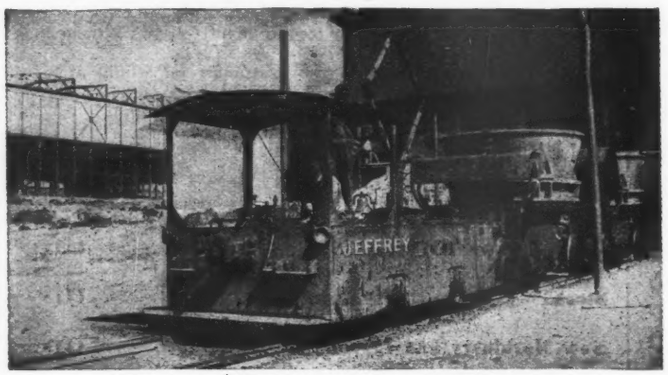


Tandem Type 6-Ton Units Jeffrey Electric Trolley Type Locomotive in operation in mines of the Arizona Copper Co., Morenci, Arizona.



3-Ton Storage Battery Locomotive hauling ore in the mines of the Portland Gold Mining Co.



20-Ton Armorplate Type Locomotive hauling slagpots at plant of the United Verde Copper Co., Clarkedale, Ariz.

Belt Conveyer with Automatic Tripper distributing to storage bins.

A Big Responsibility Rests On Men Selecting Material Handling Machinery

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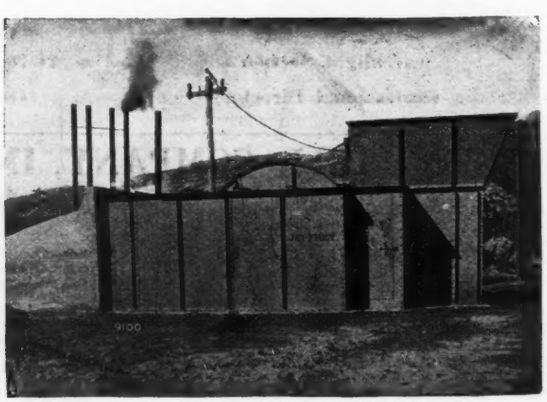
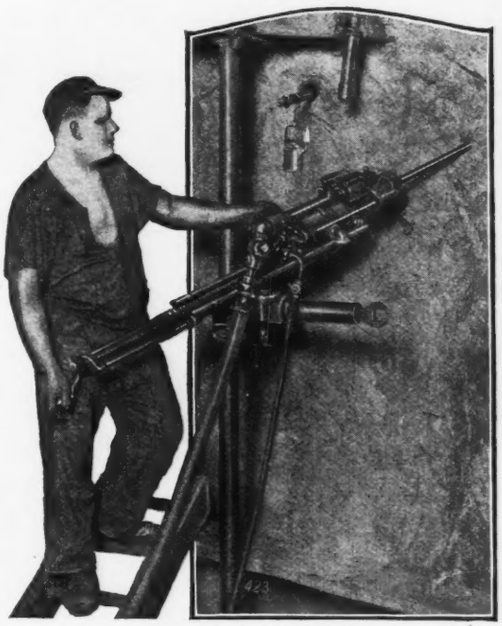


Stepped Multi-Bladed Mine Fan installed at Union Pacific Coal Co., Reliance, Wyoming.



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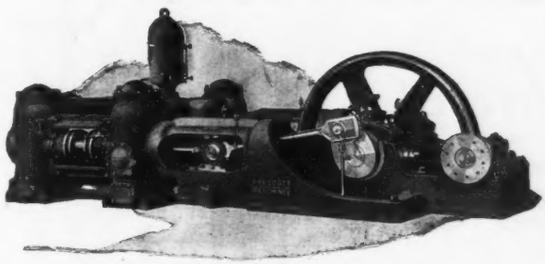
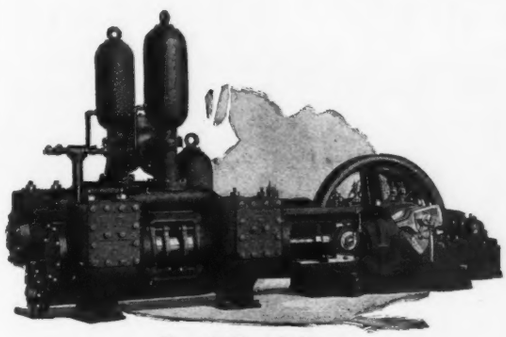
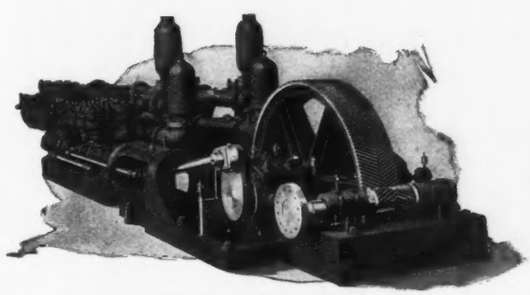


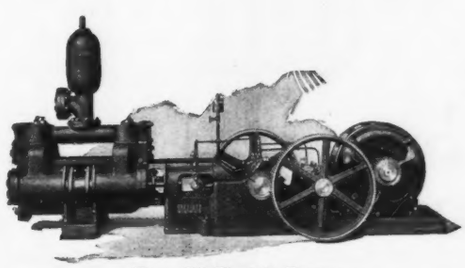
Type M Electric Pump



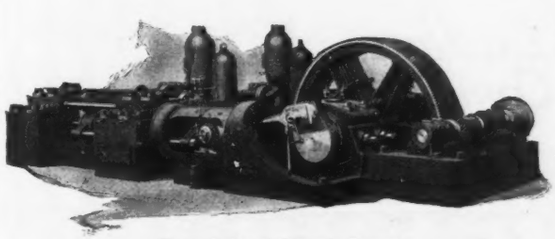
Type C Electric Pump



Pot Form Electric Pump



Type CJ Electric Pump



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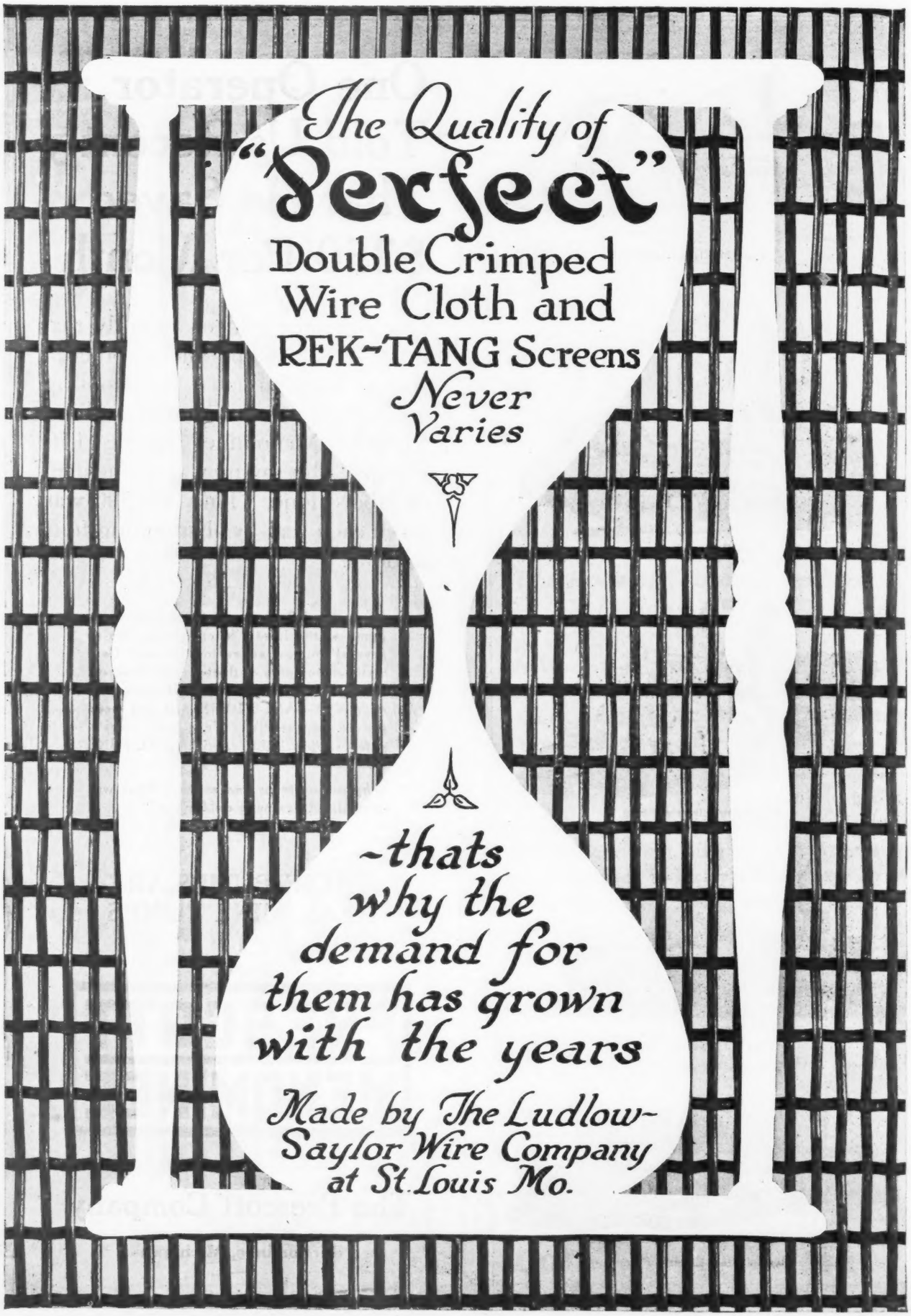
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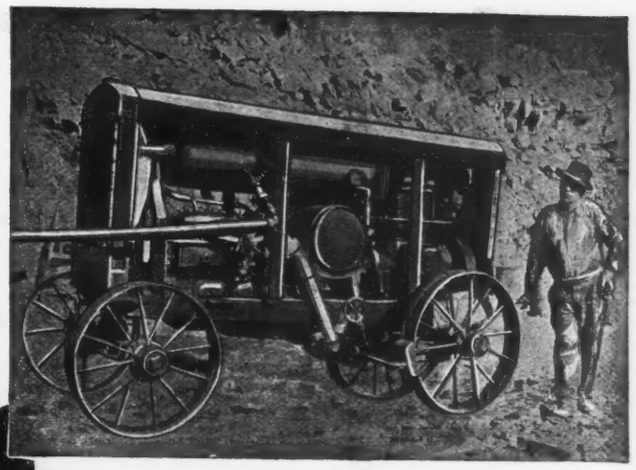

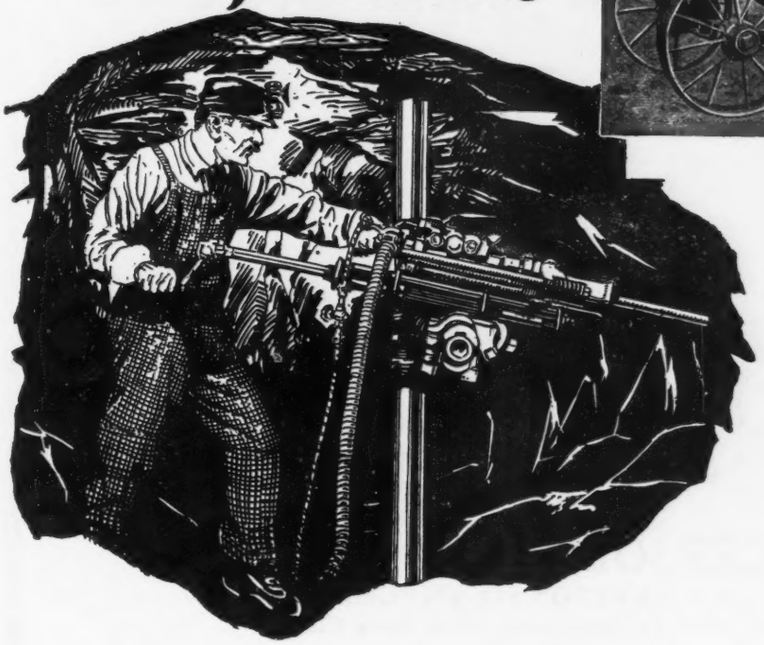

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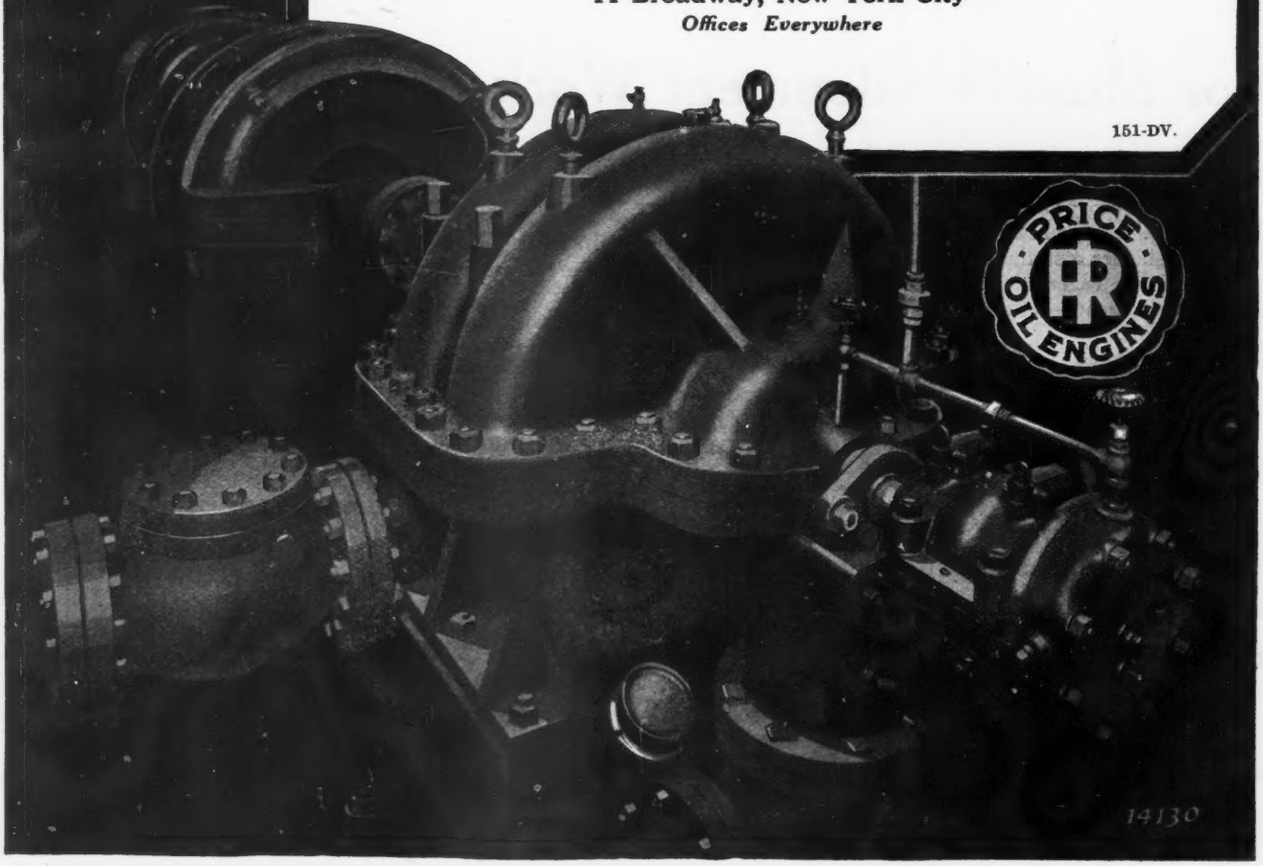
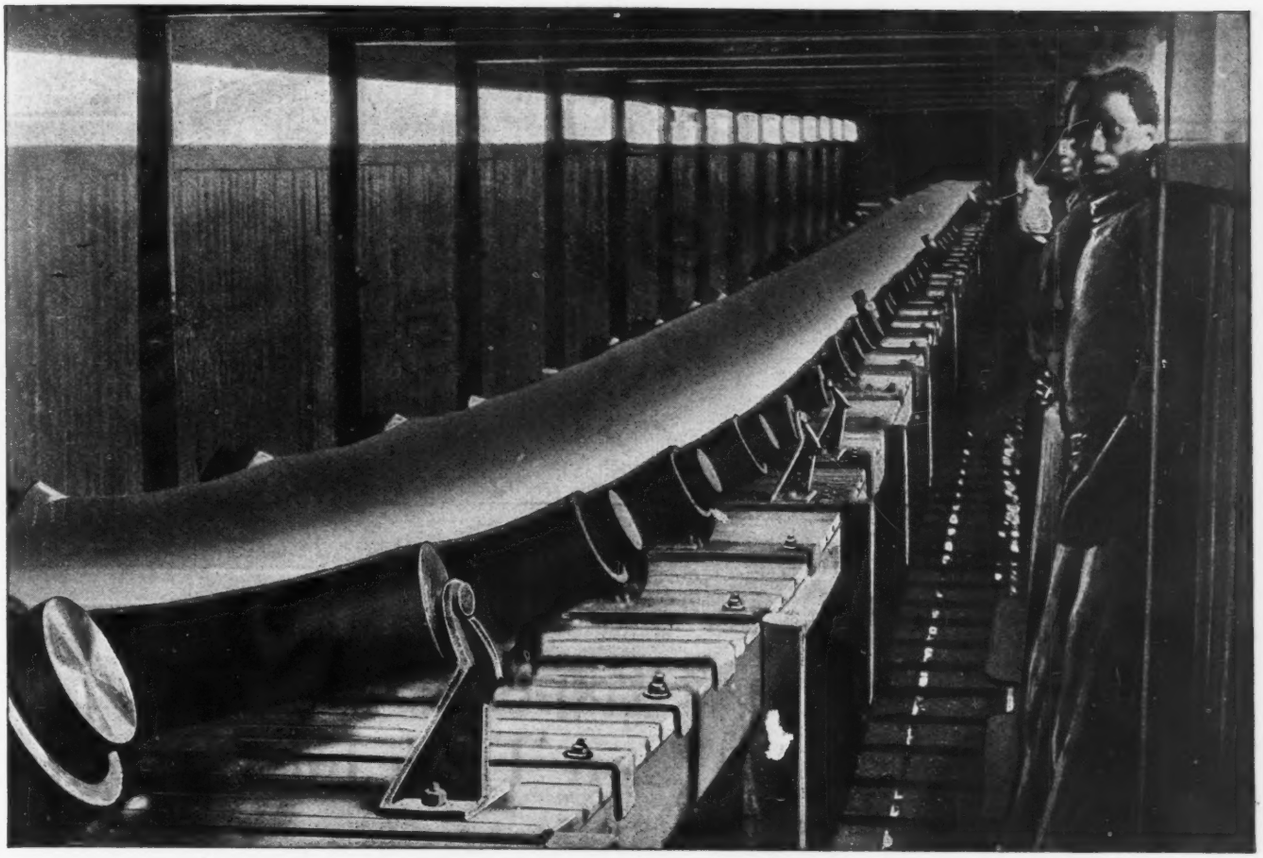
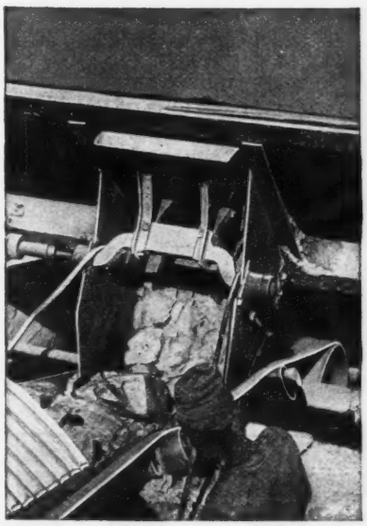




Carrying Coarse Ore in South African Gold Mines



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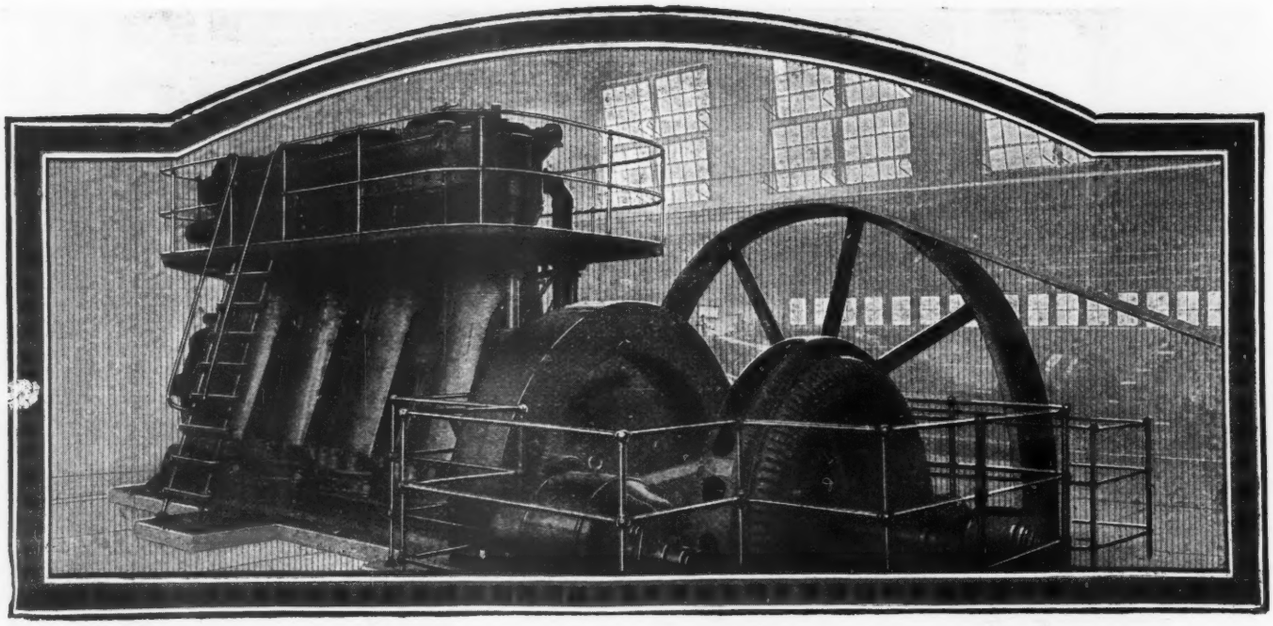

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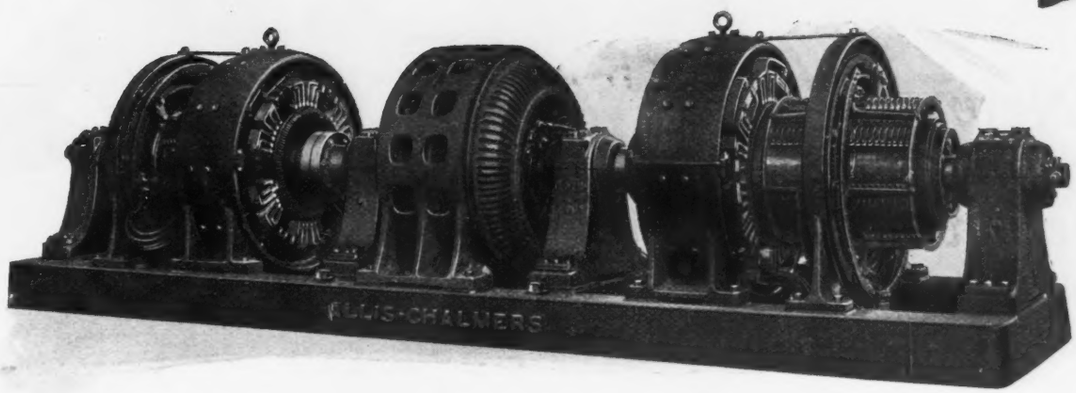

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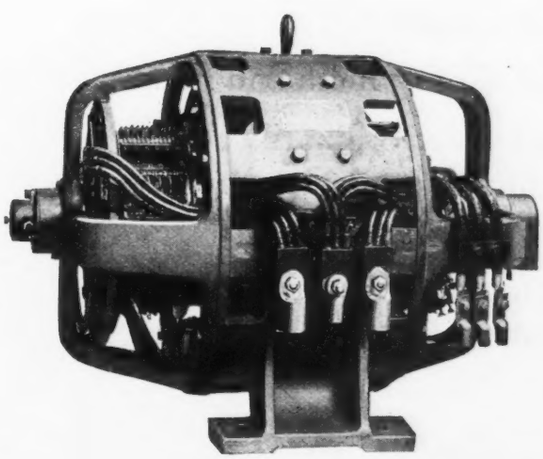
and

Synchronous Converters or Rotaries



PRODUCTS:

Electrical Machinery
Steam Engines
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Condensers
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Oil Engines
Hydraulic Turbines
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Centrifugal Pumps
Mining Machinery
Metallurgical Machinery
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Farm Tractors
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Send for Bulletins

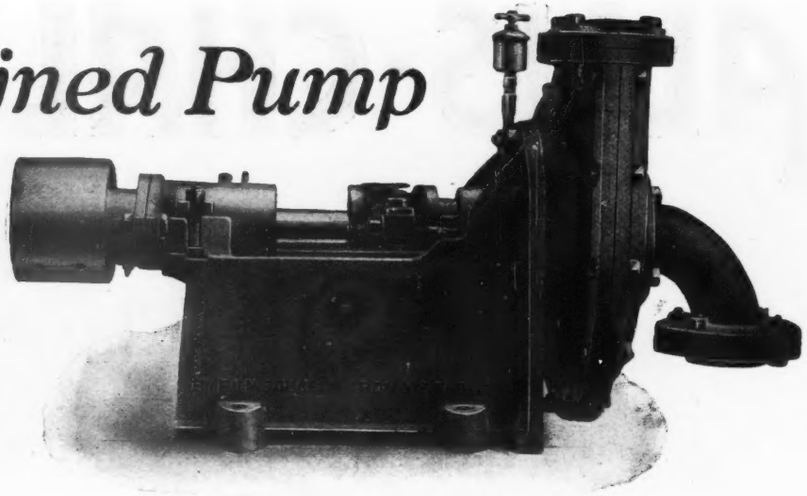
ALLIS-CHALMERS MANUFACTURING COMPANY

Milwaukee, Wisconsin, U. S. A.

District Offices in All Principal Cities

Rubber Lined Pump

a New Engineering Achievement



After months of experiment and study, the Byron Jackson Iron Works has developed a design of a rubber lined pump, whose wearing parts will have a maximum life when handling abrasive substances.

This pump is adapted to the handling of:

Mill slimes or other material of 15 mesh and finer.

Many chemical solutions which ordinarily attack iron, bronze and other metals, but which have no action on rubber.

Chemical solutions containing more or less grit. These are efficiently elevated with this rubber lined pump.

BYRON JACKSON IRON WORKS - INC.

Wherever water is to be lifted

411 Sharon Building - SAN FRANCISCO

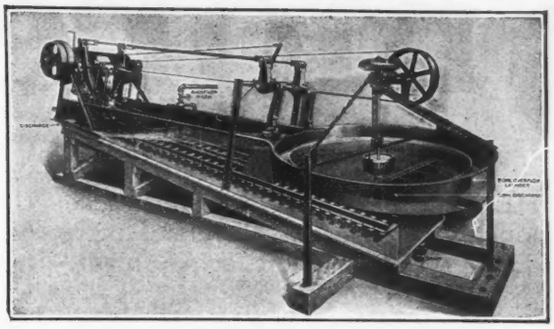
LOS ANGELES VISALIA SALT LAKE CITY PORTLAND, ORE.

DORR

Use

Dorr Bowl Classifiers

Ahead of your Concentrating Tables



Their dewatered and entirely slime-free sand-product permits:

Greater table capacity.

Increased recovery of concentrate.

Less table water.

Higher grade concentrate.

A most effective concentration of extremely fine sulfide particles, with the comparatively coarser particles in the sand product.

Use the standard Dorr Classifier with Dorr Suction Box for dewatering your table concentrate. At one plant, the addition of this Suction Box is reducing the moisture in the fine table concentrate from 18% to 10%.

The Dorr Company

Engineers

New York	Denver	London, E. C.	Mexico City
101 Park Avenue	1009 17th Street	16 South Street	Av. 16 Septiembre No. 5

DESIGN TESTS RESEARCH EQUIPMENT

1/3 more per dollar

THE DU PONT COMPANY leads the way in the production of more efficient and more economical explosives. In Dumorite, its latest achievement, it has made possible

a great step in the reduction of explosive costs

Dumorite is a new money-saving dynamite which gives you over ⅓ more work for your dollar—a guncotton-nitroglycerin dynamite without a headache—a non-freezing dynamite which can be used successfully at any temperature.

Dumorite has approximately the same strength as 40% dynamite and does the same work, stick for stick. And you can buy 135 to 140 sticks of Dumorite at the same price as 100 sticks of 40%.

Ask the du Pont Explosives Service Department through our nearest branch office how Dumorite can be used in your work. Ask that question in a letter outlining your requirements. Find out how this new development in explosives manufacture can cut your blasting costs for 1922.

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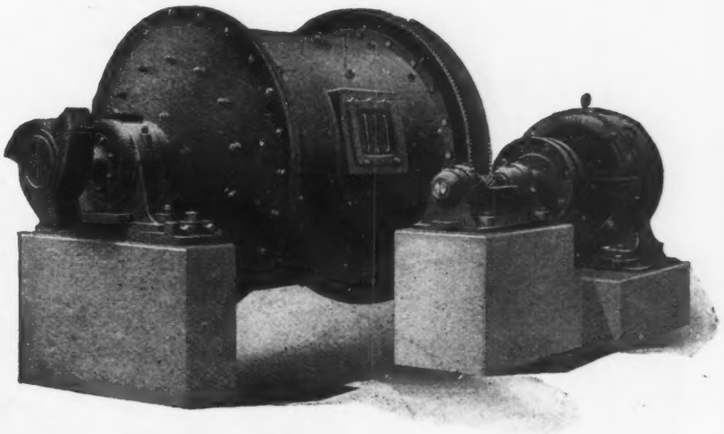
Atlantic City, N. J.

E. I. du Pont de Nemours & Co., Inc.
***Explosives Department,* Sales Division**
Wilmington, Delaware

NON-HEADACHE DU PONT NON-FREEZING

DUMORITE

ENDURINGLY EFFICIENT



Traylor Ball Mills

Tube Mills
Rod Mills
Combination Mills
Three Compartment Mills

Sturdy!
Reliable!

Every Type of Lining
Any Drive
All Sizes
For Any Service
Wet or Dry

We are just about to ship eighteen 7 ft. x 10 ft. mills to Brittannia Mining & Smelting Co., Ltd., Brittannia Beach, BC.

These mills were sold against the severest possible competition and after exhaustive investigation of designs of all bidders by the purchaser's engineers.

Bulletin No. 103P—Yours for asking.

TRAYLOR ENGINEERING & MANUFACTURING COMPANY
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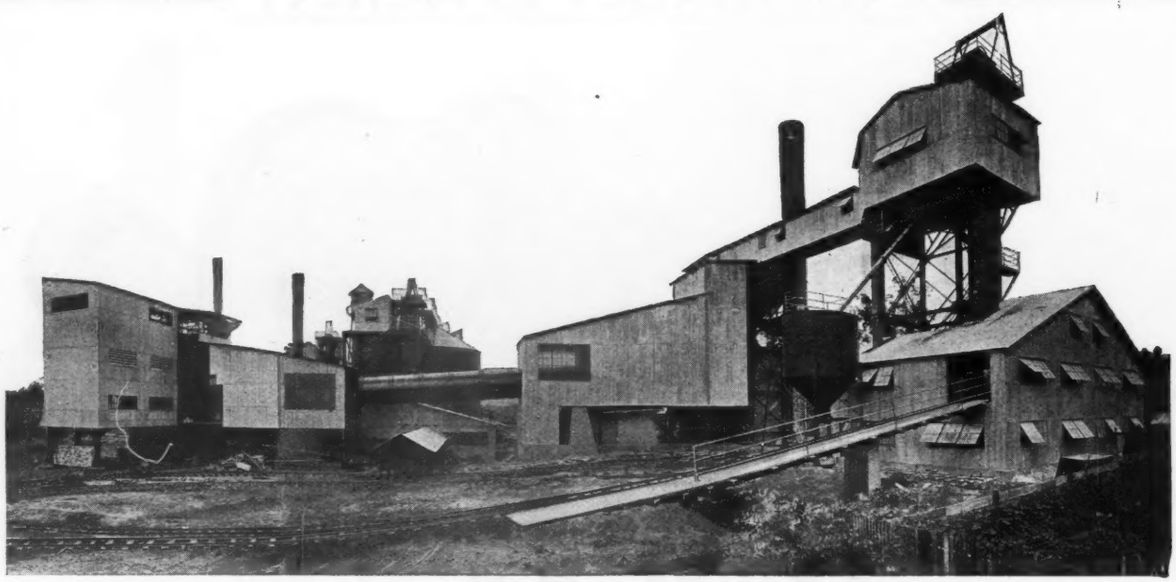


One of the 960 Vulcan Kiln Installations is near you

You will probably find it to your advantage to call on one of the concerns that have installed Vulcan Rotary Kilns. In these 960 Vulcan installations, all processes are represented.

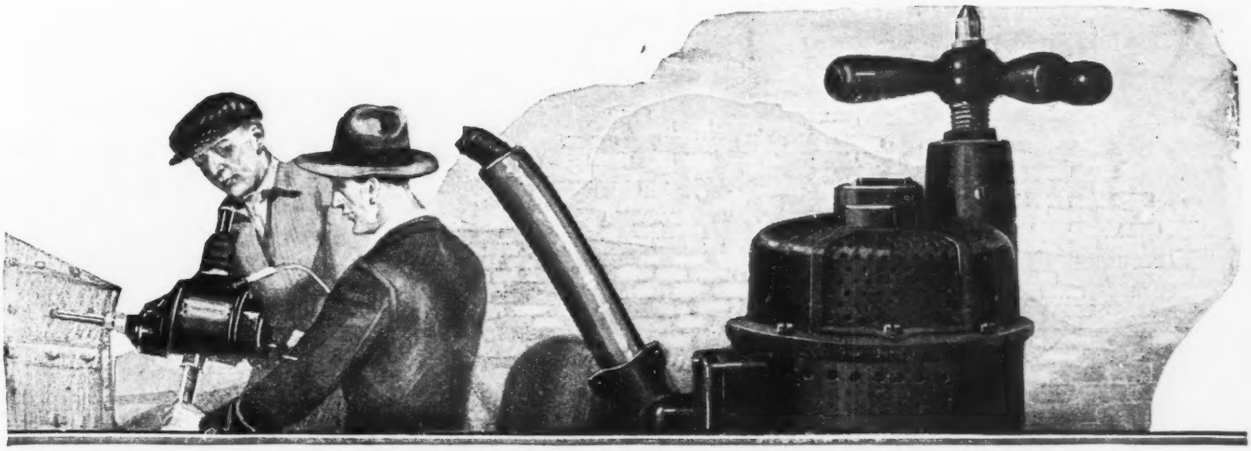
The illustration shows one 8 ft. x 150 ft. kiln in the plant of the Charles Warner Company, Cedar Hollow, Pa. The Company also operates kilns at Swedeland, Pa. The cooler is 5 ft. x 61 ft.

We'll gladly send you the names of concerns in your vicinity who have installed Vulcan Rotary Kilns; also send you Vulcan Kiln literature.

VULCAN IRON WORKS

Established 1849

1733 Main Street **Wilkes-Barre, Pa.**



The World's Most Extensively Used Portable Electric Drills

Although the man who buys a portable electric drill may care little about its mechanical construction, he is vitally interested in the *service* it will deliver. Purchasers of Little Giant Portable Electric Drills feel certain of their correct mechanical and electrical design. Their judgment in selecting "Little Giants" is confirmed by a large majority of the world's portable electric tool users and by performance records through which "Little Giants" have become famous on all classes of work.

Write for Bulletins

New uses for electric drills are being discovered daily. Every new use suggests another. It is quite likely that in some part of *your* work there is an operation which could be speeded up by the use of Little Giant Portable Electric Drills.

"Boundless Utility—

Little Giant Portable Electric Drills are manufactured in sizes as light as five pounds. They are easy to move from place to place, and may be operated in difficult positions and angles, wherever there is electric current. Possibly such a tool, operating at various parts of the plant or job, would speed up *your* output.

—Light Portability"

Chicago Pneumatic Tool Co. 6 East 44th St. New York

EL-7

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BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
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LITTLE *Electric* **GIANT** *Tools*

A Magnifier for BOTH EYES—

BINOCULAR MAGNIFIER

Chief Advantages—

Freedom of eye strain
Improvement of general definition
Perception of depth and true form
Long working distance

Metallurgical Microscopes and Photomicrographic Apparatus of all well known makes

Write for Bulletin BM-1 for prices and description of Binocular Magnifier

BRAUN-KNECHT-HEIMANN-CO

FOUNDED 1852

576-584 Mission Street, San Francisco, Calif.

Assay—Industrial—Educational
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AMSCO

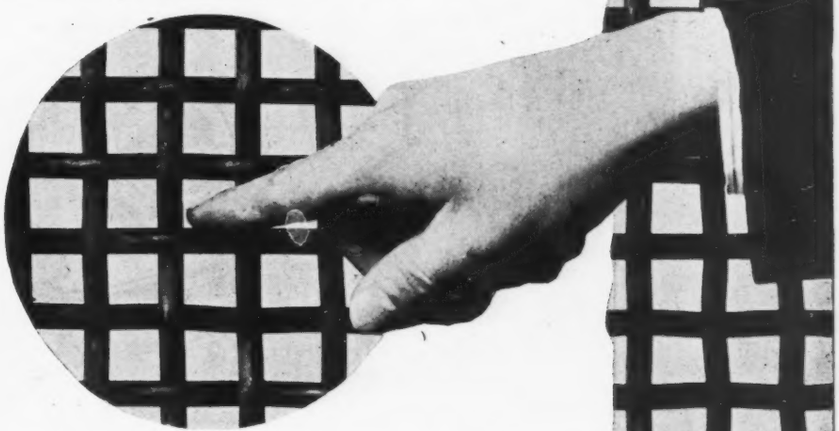
New Development Solves Screen Problems

Screens, woven from Amsco Manganese Steel rods, are a solution for the most difficult screen problems.

You mining and mill men will find that these screens set up a new standard of screen service.

Wear considered, Amsco screens are the cheapest in the end, especially in the screening of abrasive ores.

See that double crimp in the manganese wire.



Amsco screens are a development of a new process whereby we are now able to supply rolled shapes and forgings of manganese steel, in addition to castings, in almost any shape and in any quantity.

Amsco is more than a name—it is a broad helpful engineering service that aims to fit the right metal in the right place. Write us about your specific problems and let us help you solve them.

AMERICAN MANGANESE STEEL COMPANY

General Offices
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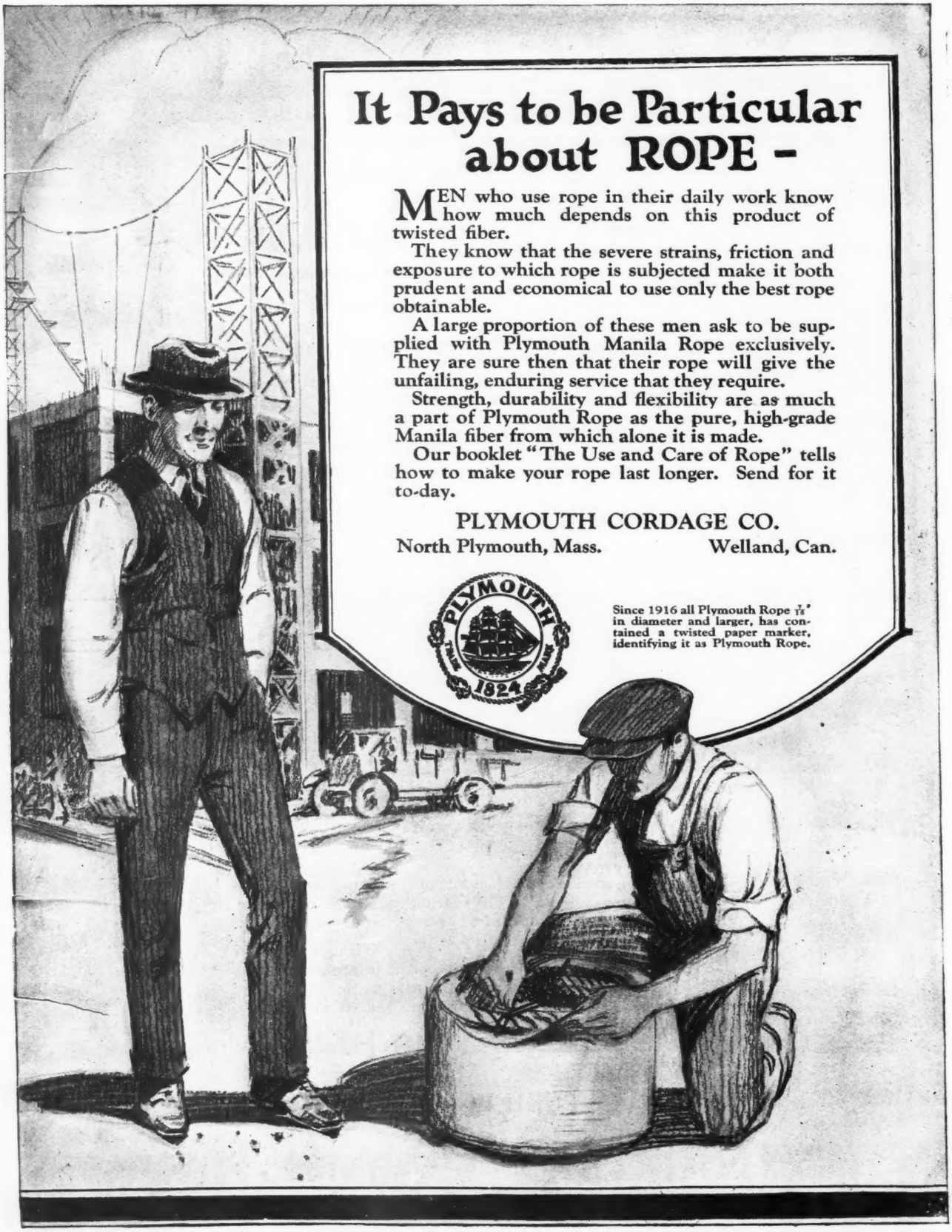
Plants
Chicago Heights, Ill. Newcastle, Del. Oakland, Cal.



It Pays to be Particular about ROPE –

MEN who use rope in their daily work know how much depends on this product of twisted fiber.

They know that the severe strains, friction and exposure to which rope is subjected make it both prudent and economical to use only the best rope obtainable.

A large proportion of these men ask to be supplied with Plymouth Manila Rope exclusively. They are sure then that their rope will give the unfailing, enduring service that they require.

Strength, durability and flexibility are as much a part of Plymouth Rope as the pure, high-grade Manila fiber from which alone it is made.

Our booklet "The Use and Care of Rope" tells how to make your rope last longer. Send for it to-day.

PLYMOUTH CORDAGE CO.

North Plymouth, Mass. Welland, Can.

PLYMOUTH 1824

Since 1916 all Plymouth Rope $\frac{1}{16}$" in diameter and larger, has contained a twisted paper marker, identifying it as Plymouth Rope.

PLYMOUTH *The Rope You Can Trust*

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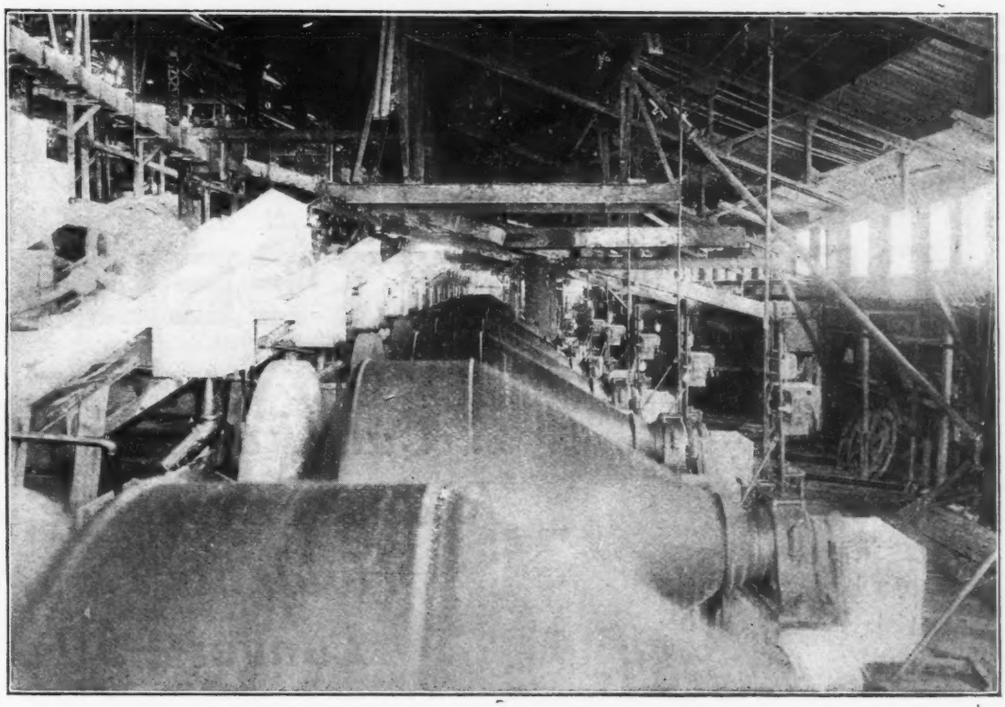


American Smelting and Refining Co. Orders Another Hardinge Mill

This is the second order received from this Company within the last three months.

The Hardinge Mill has taken part in so many tests and won, that no longer do the leaders hesitate in making their selection.

Here is another instance where a Company, well able to make the most exhaustive study, has cast its lot with the Hardinge Mill.

Could there be a stronger endorsement of the grinding principle of the Conical Mill?

HARDINGE COMPANY

WORKS YORK, PENNA. DENVER, COLO. ERITH, ENG.

120 BROADWAY, NEW YORK, N.Y.

BRANCH OFFICES

SALT LAKE CITY, UTAH; NEWHOUSE BUILDING

LONDON, ENGLAND; 11 SOUTHAMPTON ROW

CABLE ADDRESS "HARDINGMIL NEW YORK"

RED STAR VANADIUM DRILL STEEL

Cuts Faster—100%
Reduces Breakage—50%
Holds its Gauge Longer—50%

THESE records are not merely our own tests—they are averages from the reports of mining companies. In every case they represent actual drilling by Red Star VANADIUM Drill Steel in their own mines.

Red Star VANADIUM is upsetting all known standards for Drill Steel endurance, and for speed in cutting. It is proving a surprise in every mine where it is used. Continued repeat orders indicate it is a satisfactory surprise.

Red Star VANADIUM results in your own mine will be the best evidence of its practical profit to you.

At present we can make immediate mill shipment of all sizes. Write or wire nearest branch.

For Dies and Dollies

A Vanadium Tool Steel—father of Red Star Vanadium.

COLONIAL No. 7 TOOL STEEL

"My observations over a period of two years show that the dies and dollies made from your Colonial No. 7 give from 200% to 300% longer service."

"One of its attractive features is the ease with which it can be satisfactorily hardened in our mine blacksmith shop."

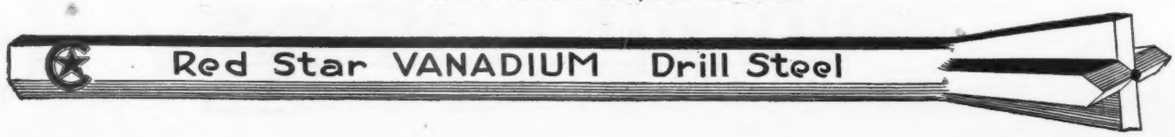
(Name on request)

You can get better results from your drill sharpeners, and save money, with COLONIAL No. 7.

Colonial Steel Company

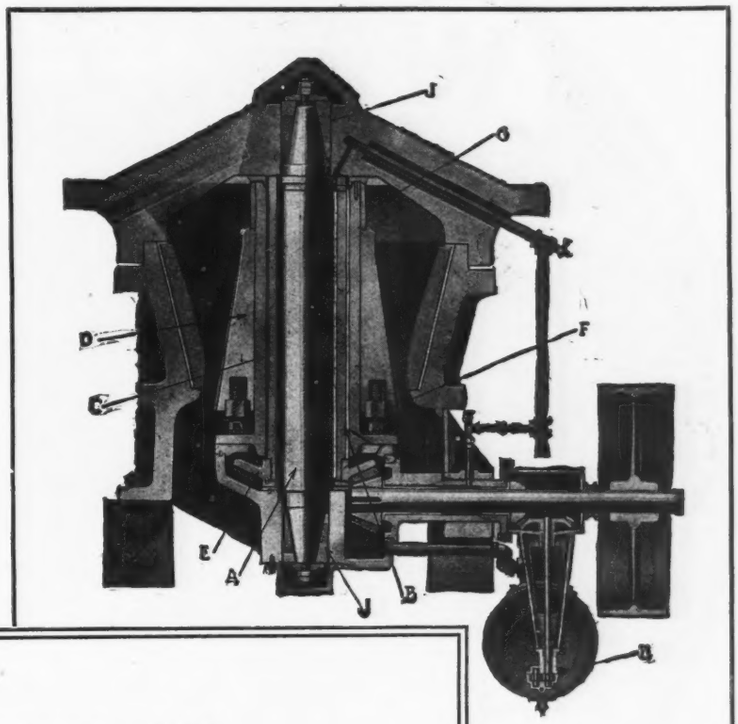
Pittsburgh Birmingham New York Denver Chicago Salt Lake City St. Louis

EDW. L. SOULÉ CO., San Francisco



Sectional view of Telsmith Primary Breaker. Parts lettered are as follows:—A, rigid central shaft; B, sleeve eccentric; C, flanged head liner, on which head is adjusted; D, crushing head (does not rotate); E, cast steel gear; F, jackscrews for adjusting head; G, split distance rings, (set furnished for different bottom openings); J, expansible taper bushings; K, oil pump.

FIVE TELSMITH FEATURES THAT COMMAND ATTENTION



1—Shaft is guaranteed *absolutely unbreakable.*

2—Receiving and crushing areas are 20-30 per cent greater than in any other gyratory breaker.

3—Crushing pinch is parallel to axis of crusher—just as long at top of the head as at the bottom. *No slippage* even with smooth gravel-boulders.

4—Crusher structure is shorter, stronger and heavier (per inch of height) than in any other machine.

5—Force-feed lubrication and perfect exclusion of dirt, Big reserve of oil, with constant cooling, straining and deposition of extraneous matter.

Write for our Catalog No. 155 (Telsmith Primary Breakers) and Bulletin No. 2F2 (Telsmith Reduction Crusher).

SMITH ENGINEERING WORKS

3195 Locust St., Milwaukee, Wis.

Canadian Representatives: Canadian Ingersoll-Rand Co., Montreal, P. Q.

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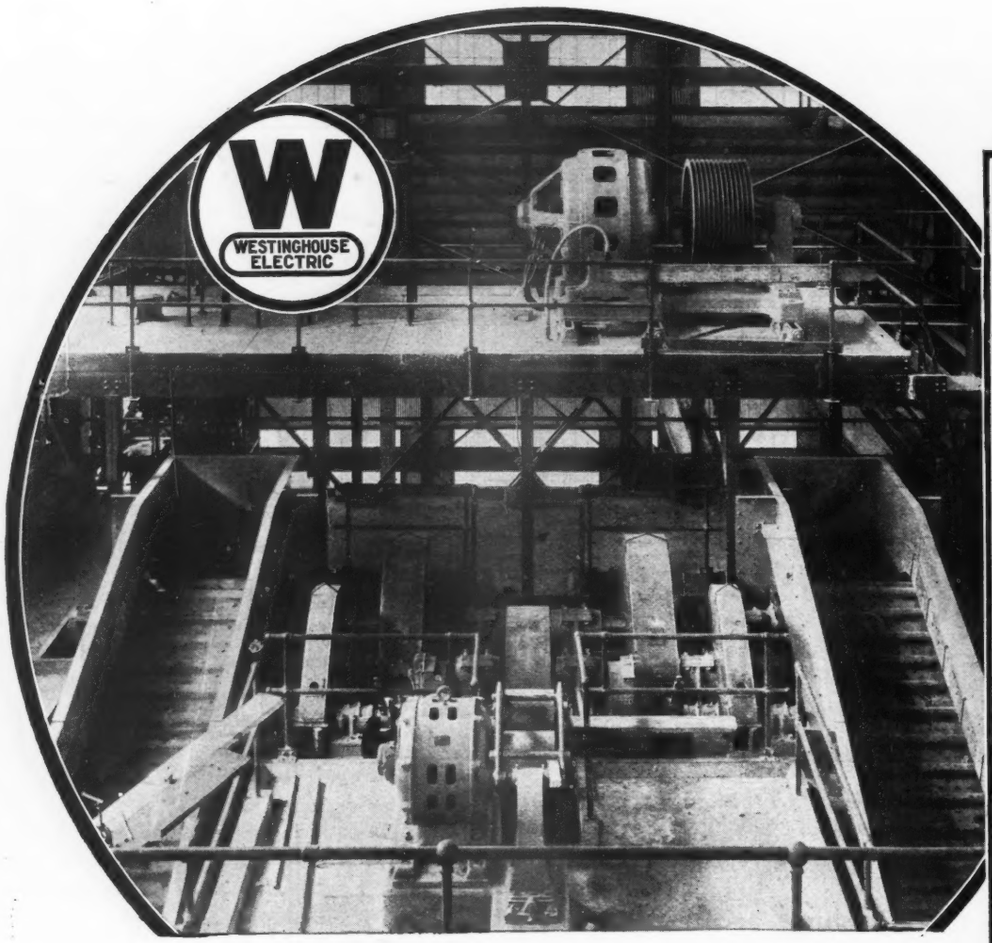


Up or Down?

In looking for a way to reduce production costs, you have no doubt considered the use of electricity.

When you think of electric operation, do not think of it merely as a more efficient way to apply the power that is generated in your plant or purchased from the central station.

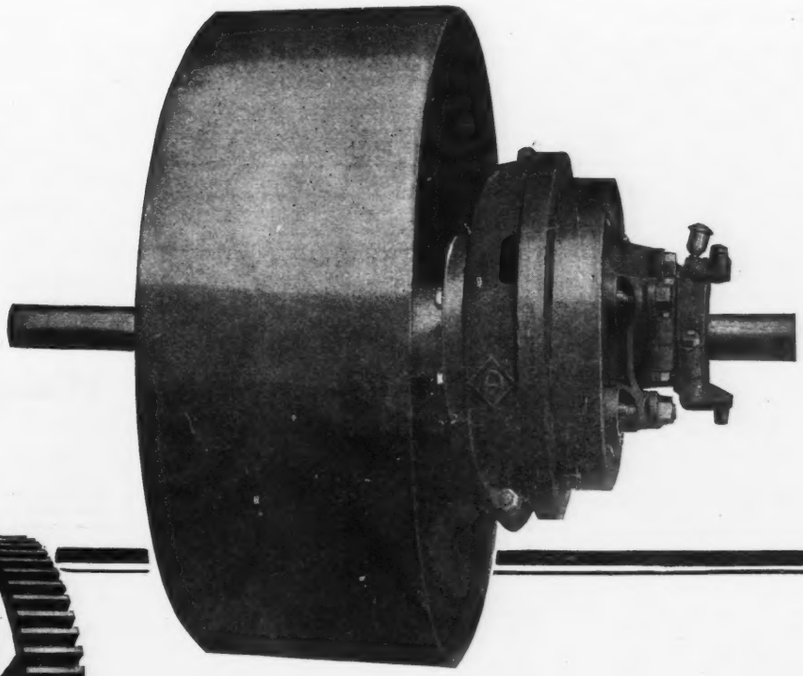
Think rather of the conveniences of electric operation—of operations facilitated by the use of electrical apparatus. Think of speedier operation—speedier haulage.

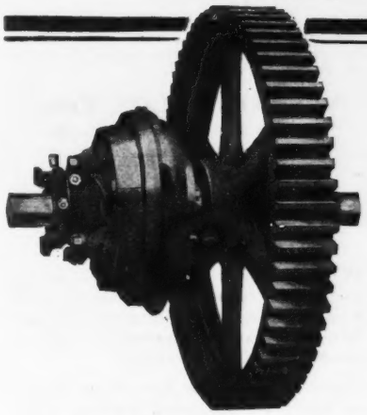
Think of electricity as a means of reducing the cost per ton by increased output at the mine within a given time.

Westinghouse engineers will be glad to review any power problem with you and will offer the best recommendations that a wide experience can afford.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.
Sales Offices in All Principal American Cities

Westinghouse





Dodge Split Clutch with Dodge Spur Gear mounted on sleeve.

Dodge Split Clutch with Rope Sheave mounted on sleeve.

Individualize your mill units with Dodge Friction Clutches

Conservation of power and money by the segregation of machines or groups is economically accomplished in a Dodge installation by the use of friction clutches or cut-off couplings. This makes possible individualization of machines or departments with relation to the central power plant—eliminates shut-down losses due to one machine break-downs.

Thousands of these clutches have more than paid for themselves during their first year of operation.

The selection of type (solid or split) except where conditions specifically demand a certain type is largely a matter of preference. However, when the selection is made on a quality and efficiency basis the choice must invariably be Dodge.

Dodge equipment costs less to operate and replace than non-mechanical equipment—the reuse value is unusually high because they are built for use on any lineshaft and not as a specially designed unit for a single machine.

Dodge Friction Clutches are stock products which can be purchased from your local dealer on the immediate delivery basis.

DODGE

Dodge Sales and Engineering Company

General Offices: Mishawaka, Ind. Works: Mishawaka, Ind. and Oneida, N.Y.

Power Transmission Machinery-Elevating and Conveying Equipment-Heavy Oil Engines

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Philadelphia
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EMPLOYMENT SERVICE

A LEADING organization desiring to fill an important position, for obvious ethical and other reasons, cannot invite directly the candidacy of any particular man. Similarly, no well-connected man will exploit personally his own qualifications, no matter how receptive he may be to overtures. The undersigned has been retained by a national clientele for many years, as a medium for negotiating preliminaries in such cases. Your permission to send booklet discussing this problem and describing the service, will in no degree obligate or compromise you. Strictly confidential. R. W. Bixby, Inc., 308 Lockwood Building, Buffalo, New York.

POSITIONS WANTED

DOCTOR—Graduate Class A School. One year hospital internship. Eight months post-graduate work. Four years' mining practice in Mexico. Speak Spanish. Sober. Address Dr. B. O. Thrasher, 607 North Oregon Street, El Paso, Texas.

ELECTRICAL, mechanical engineer; thorough practical experience in construction and maintenance of mine and mill equipment; efficient operation of power plant; can handle men; location anywhere. PW-457, Eng. & Min. Journal-Press.

ENGINEER, accountant, expert accountant, 5 years' experience in mine accounting and statistical work, 9 years' general mining experience, graduate mining engineer, fully acquainted with constructive detail work and installation of cost, statistical and accounting systems, at present employed but will be open for new engagement soon. PW-453, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

FOREMAN or shift boss; Mexico or Southwest; 14 years' experience in Mexico and Central America; a hustler, reliable and trustworthy; references by wire or mail; will be available July 1st. PW-455, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

GRADUATE engineer 8 years' experience in ore concentrating and leaching processes; 10 years' in active charge of metal mining properties in Missouri and Rocky Mountain districts. PW-440, Eng. & Min Journal-Press, Old Colony Bldg., Chicago, Ill.

MASTER mechanic and chief electrician. 41, married, three years' technical training sixteen years' general experience. Capable of taking entire charge of mine mill or smelter machinery; at present employed in Central Mexico available on thirty days notice. PW-438, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

METALLURGIST—Wide experience operation, organization and in developments of new plants and processes. Best education, 15 years' executive wishes leading position pioneer work or old problems, chemical or metallurgical nature. PW-390, Eng. & Min. Journal-Press.

METALLURGIST, technical graduate, single, desires position as mill superintendent or ore testing engineer; 10 years' experience milling and flotation; 3 years in research laboratory large copper smelter, testing oils and ores for flotation. PW-454, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MILL superintendent or general foreman wishes new connection; 13 years' experience cyanidation, concentration, flotation; married, age 32; technical training; Mexico experience; references. Box 7, Pearce, Ariz.

MILL superintendent, metallurgist, with long, varied experience milling, cyanidation, gold or silver ores, foreign practice, desires charge of plant; expert ball-mills and counter-current decantation; graduate, unmarried, Spanish. PW-442, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING engineer, with many years' experience in mine and mill operation, construction and examination, wants suitable position. PW-451, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING executive, technical graduate; 12 years' broad mining experience, at present superintendent; speaks Spanish; salary $500. PW-423, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

MINING engineer; experience covers engineering, shift boss, mine foreman, underground superintendent and assistant mine superintendent; available on thirty days' notice to present employers; speaks Spanish. PW-424, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

MINING engineer, now managing small mine, desires greater field for capabilities; $400 per month up, according to conditions; might take interest in attractive enterprise. PW-452, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING engineer, 20 years' as engineer, superintendent and manager in United States and Latin-America desires position. Wide experience in construction, development and operation. PW-439, Eng. & Min. Journal-Press, Real Estate Trust Bldg., Phila., Pa.

SUPERINTENDENT, mine or mill, competent, dependable, eighteen years' experience Western States and Alaska in mining, milling, cyanidation and flotation of gold, silver and allied ores; last two years with mica; available now; A1 references from past employers. Reply PW-456, McGraw-Hill Co., Colorado Building, Washington, D. C.

SUPERINTENDENT or manager. Position desired by technical graduate, seventeen years' experience, development and operation of mining properties; Western States and Mexico. Contact and vein deposits. Spanish spoken. PW-444, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

EXTRA WORK WANTED

AMERICAN engineering draftsman, mech.-struct., desires extra work in designing and detailing building or special machines; San Francisco resident. EWW-450, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

EXECUTIVES

Engineers and men of proven ability seeking positions, find our service satisfactory. Our Mr. H. H. Harrison can confidentially negotiate for you suitable connections, as he has successfully done for thousands of others since 1909. Inquiries invited.

The National Business Bourse, Inc.
Confidential Negotiators
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Mining Property for Lease

Valuable silver-lead mining property belonging to A. E. Reynolds estate and located mainly in Colorado will be leased on reasonable terms and royalties to responsible parties for operation.

Full particulars on request. This estate controls over ten thousand acres of the recognized most valuable mining properties in Colorado.

A. E. REYNOLDS, *Estate*
1555 Sherman Street, Denver, Colo.

PRECIOUS METAL ORES

Wanted—ores containing silver, gold or platinum to be recovered by means of an entirely new process. We are also interested in galena, copper and iron pyrite.

Great opportunity for mine owners or owners of mineral rights. Give price per ton and full particulars as to quantity and quality.

Address Station D. Box 74, New York City

A MINERAL COLLECTION WITH EVERY IMPORTANT MINERAL

135 specimens in collection, good sized, each specimen with label attached giving name, chemical nature and locality. An ideal collection for a study and display, $28.50 delivered. Booklet of collection gladly sent.
I purchase beautiful and interesting mineral specimens.

GEORGE S. SCOTT
20 Nassau Street, New York

MACHINERY FOR SALE

CENTRIFUGALS—60, 44, 40 and 32-in. iron basket; 48, 40 and 26-in. copper basket.

COOKERS—24 ½ x 7 ½ ft., 5 x 16 ft., 3 x 16 ft., with stirrer and steam jacket.

DRYERS—Direct-heat rotary dryers, 3 x 25 ft., 3 x 30 ft., 3 ½ x 25 ft., 4 x 30 ft., 4 ½ x 30 ft., 5 x 35 ft., 5 ½ x 50 ft., 5 ½ x 60 ft., 6 x 50 ft. and 7 x 50 ft.; double shell dryers, 3 x 16 ft., 4 x 20 ft., 4 ½ x 26 ft., 5 x 30 ft. and 6 x 35 ft.
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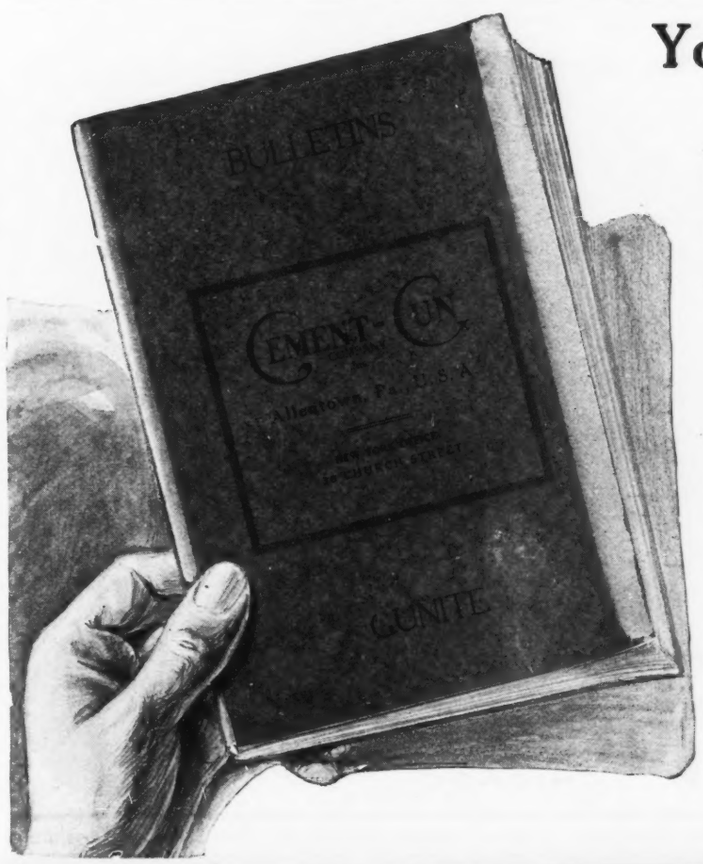

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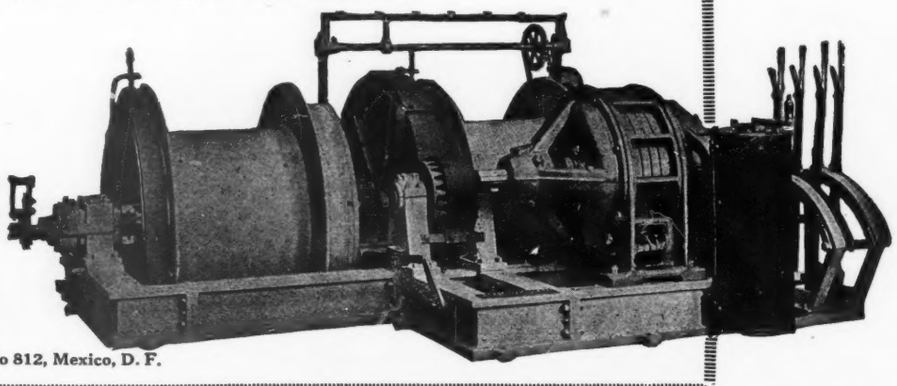

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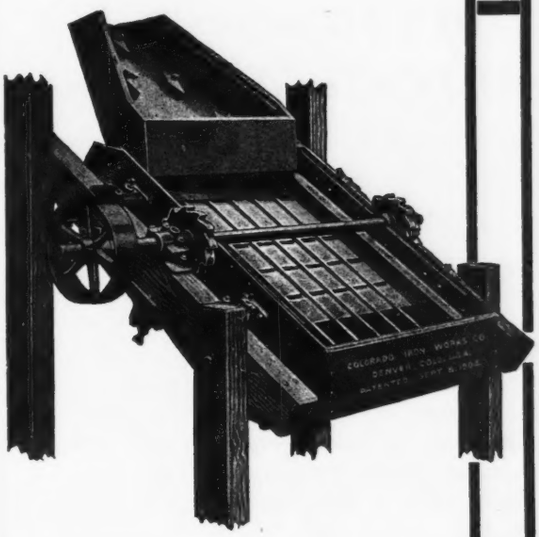

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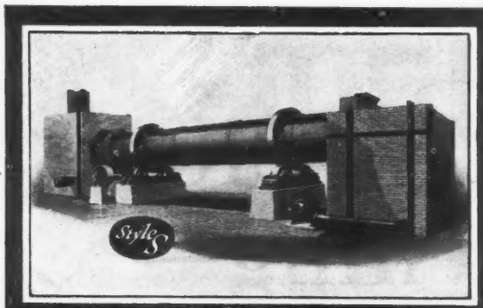

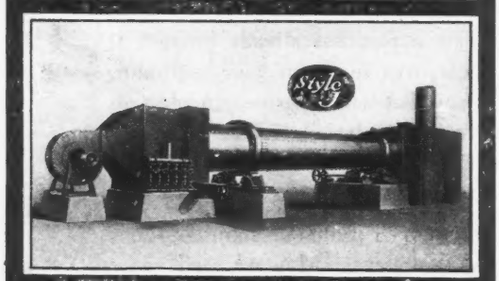

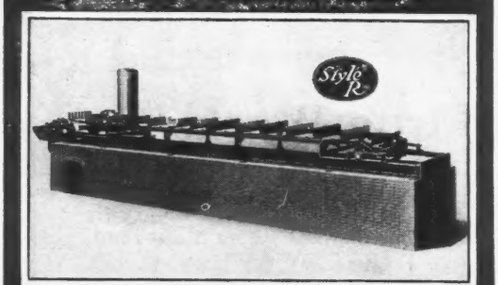

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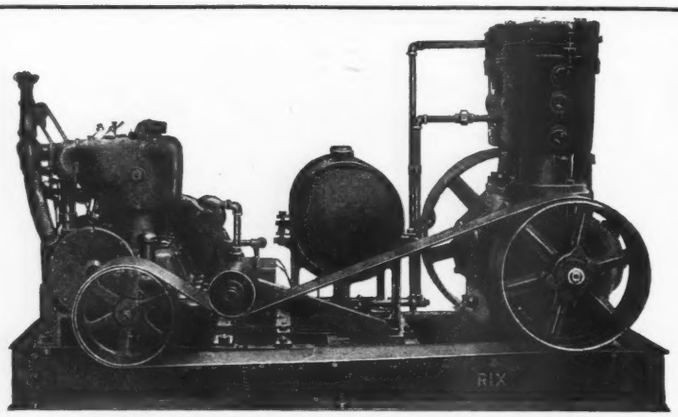

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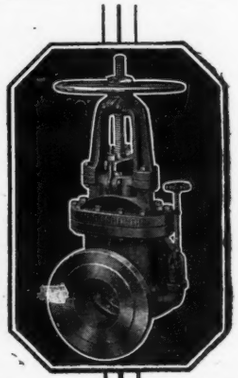

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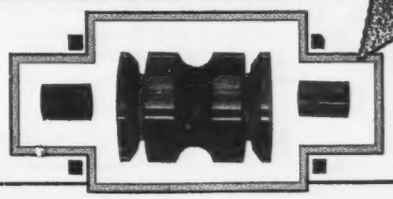

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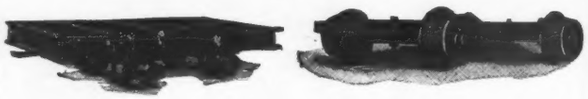

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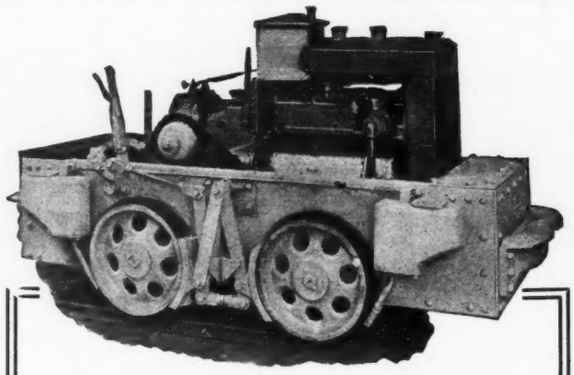

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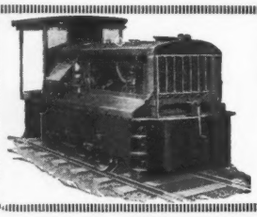

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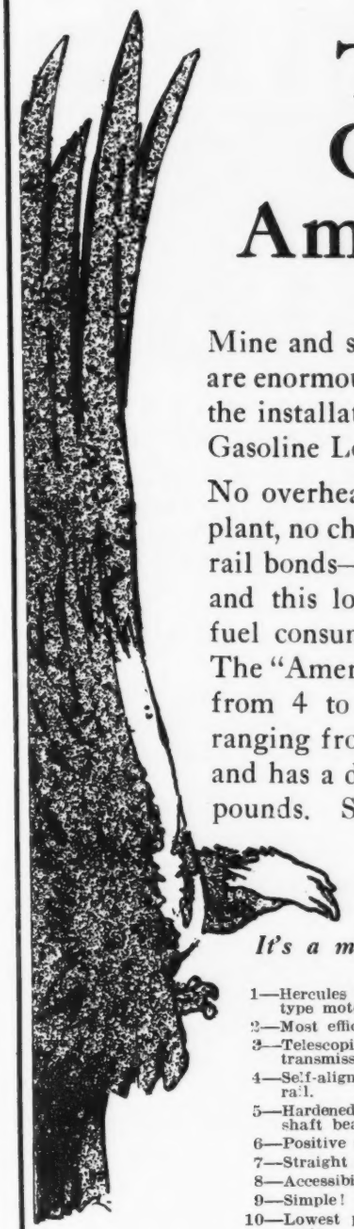

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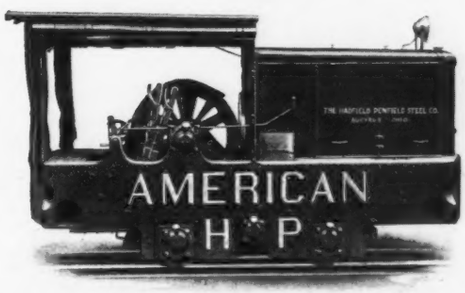

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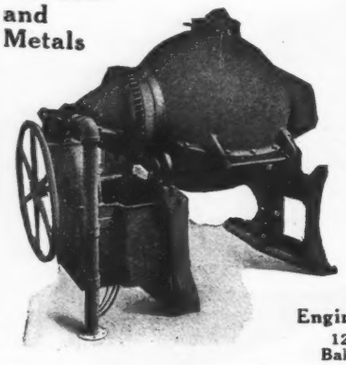

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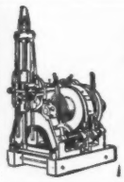

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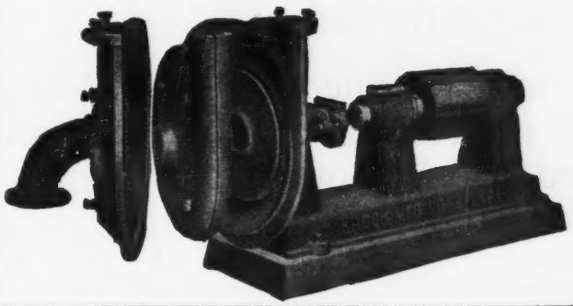

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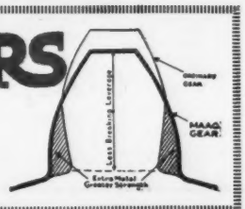

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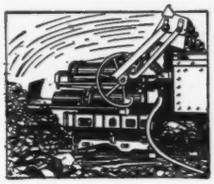

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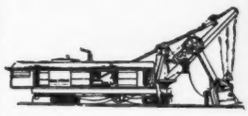

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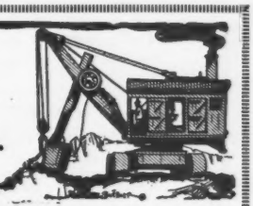

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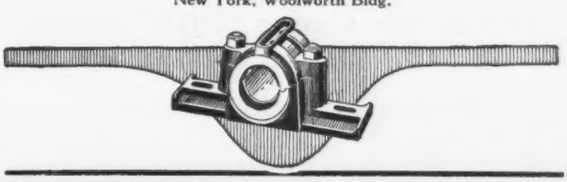

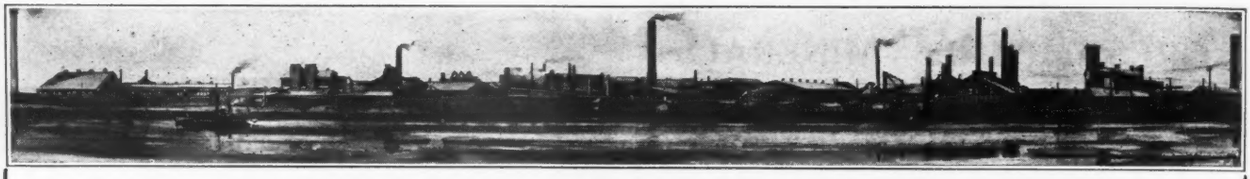

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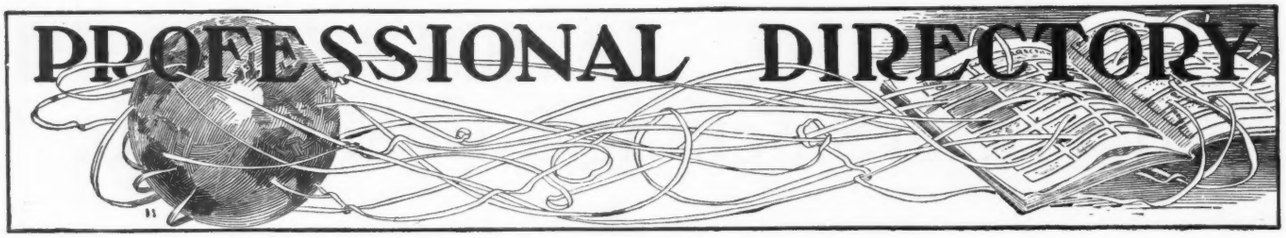

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Cars, Mine Roller Bearing
Ottumwa Iron Works

Cars, Hopper
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

Cars, Mine
Ingersoll-Rand Co.
Watt Mining Car Wheel Co.

Cars, Ore
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

Cars, Quarry
Atlas Car & Mfg. Co.
Watt Mining Car Wheel Co.

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Chains, Transmission
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Stephens-Adamson Mfg. Co.

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Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
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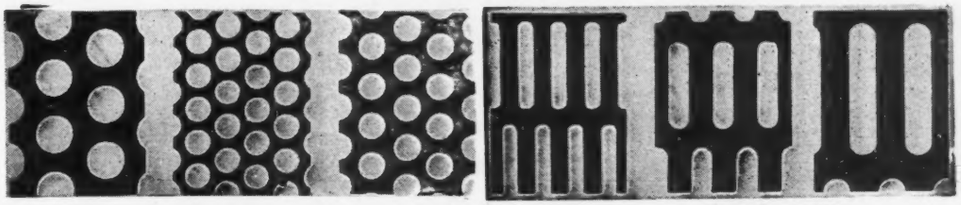

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Rix Compressed Air & Drill Co.
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Hoists, Mine Compressed Air
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Hoists, Mine Steam
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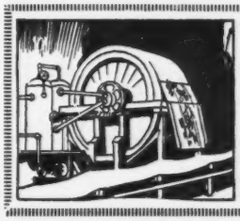

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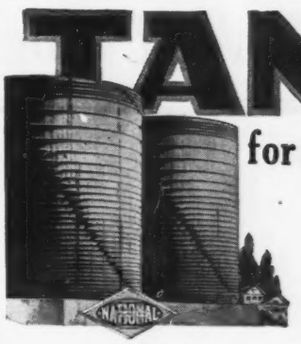

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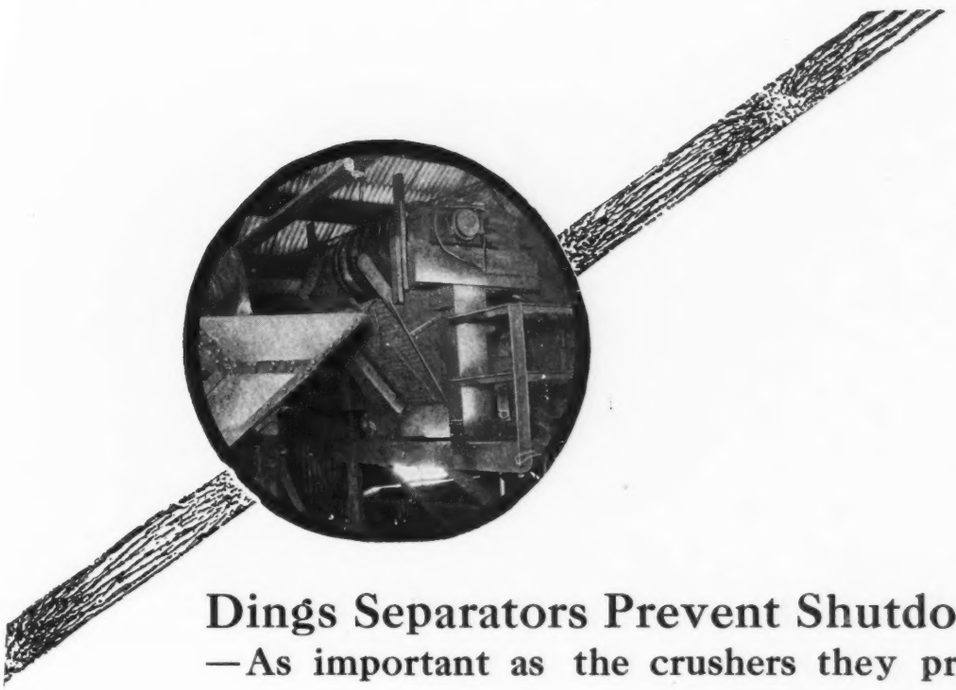

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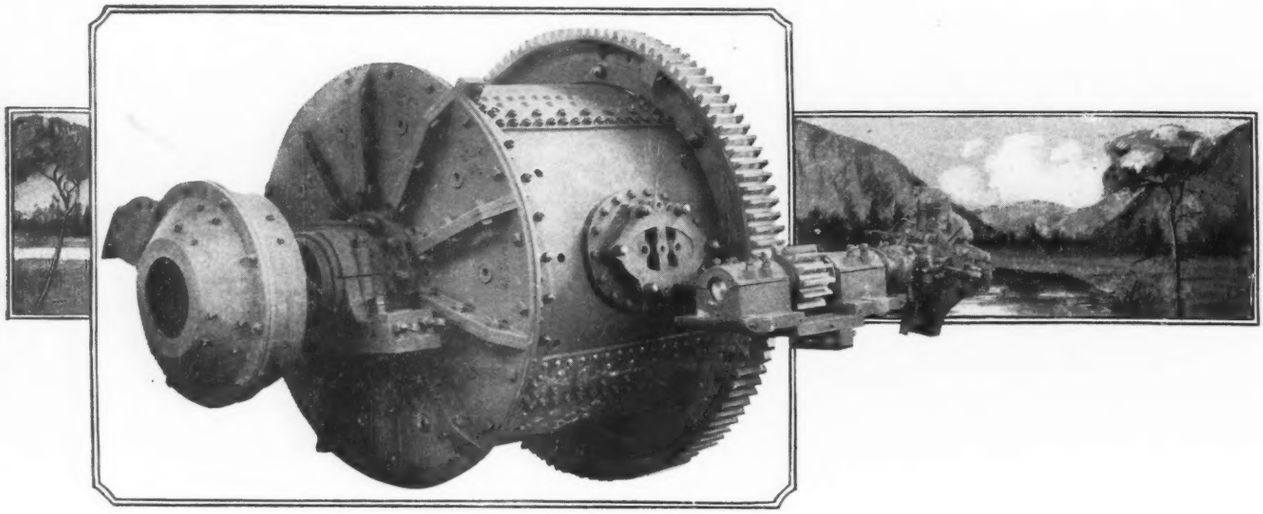

Ship Them a Mill That You Know Is Right

These Are the Principles of Marcy Ball-Mill Crushing

1. The low pulp line or a small amount of pulp carried in the mill permitting maximum efficiency of the grinding medium as the Marcy low pulp line reduces to a minimum the buoyant effect of the pulp on the balls.

2. Grinding in thick pulp thus thoroughly coating the grinding medium and liners and resulting in maximum grinding efficiency.

3. Rapid circulation of mill contents. This is possible with the Marcy low pulp line principle which permits of the removal of tne finished product from the mill rapidly and the return of the oversize by means of classifiers or screens for regrinding.

The men you hold responsible for successful production need the best mill you can get for them. And this is especially true if they are located in an out-of-the-way place, dependent on mule-back transportation, or in a foreign country where it takes a long time to get parts.

MARCY BALL MILLS, from three to five foot sizes will meet your requirements. Skilled operators are not necessary to keep them going. All wearing parts are heavy and made of tested materials, thus insuring long life and maximum operating time. They can be sectionalized for transportation to remote and mountainous places. MARCY BALL MILLS do make it possible to have an efficient small milling plant no matter where your property is located.

The services of Marcy engineers are available to advise at all times on any problem. Write our nearest office.

The Mine and Smelter Supply Co.

Denver **Salt Lake City** **El Paso**

New York Office:
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